TECHNICAL DATA FILE
Calibration Div.

TM 9-4931-443-14-1

C1, 14apr75

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT

AND GENERAL SUPPORT MAINTENANCE MANUAL

C1

Including Repair Parts and Special tools list

# AC PRECISION POWER SUPPLY

## NH RESEARCH, INC. MODEL SF 613-1

(4931-00-113-0801)

HEADQUARTERS, DEPARTMENT OF THE ARMY

9 JUNE 1972

This manual is an authentication of the manufacturer's commercial literature which, through usage, has been found to cover the data required to operate and maintain this equipment. Since the manual was not prepared in accordance with military specifications, the format has not been structured to consider level of maintenance nor to include a formal section on depot overhaul standards.

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Technical Manual
No. 9-4931-443-14-1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., *9 June 1972*

# OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL, INCLUDING REPAIR PARTS AND SPECIAL TOOLS LIST: AC PRECISION POWER SUPPLY, NH RESEARCH, INC. MODEL SF 613-1 (NSN 4931-00-113-0801)


| | | Page |
|---|---|---|
| Section | 0. Introduction | 0-1 |
| Chapter | 1. SF 613-1 EXCITER UNIT (LESS OSCILLATOR ASSEMBLY) | |
| Section | 1. Specifications | 1-1 |
| | 2. Operating Instructions | 1-4 |
| | 3. Theory of Operation | 1-5 |
| | 4. Maintenance | 1-8 |
| | 5. Maintenance Calibration | 1-12 |
| | 6. Schematics | 1-15 |
| | 7. Parts Provisioning List and Component Locations | 1-21 |
| Chapter | 2. SF 613-1 OSCILLATOR ASSEMBLY (KROHN-HITE, MODEL 4000R-7) | |
| Section | 1. General Description | 2-1 |
| | 2. Operating Instructions | 2-6 |
| | 3. Circuit Description | 2-10 |
| | 4. Maintenance | 2-15 |
| | 5. Maintenance Calibration and Adjustment | 2-25 |
| | 6. Parts Provisioning List, Schematics, and Component Locations | 2-31 |
| | 7. Federal Supply Code for Manufacturers | 2-46 |
| Chapter | 3. SF 613-1 POWER UNIT | |
| Section | 1. Specifications | 3-1 |
| | 2. Operating Instructions | 3-4 |
| | 3. Theory of Operation | 3-8 |
| | 4. Maintenance | 3-18 |
| | 5. Maintenance Calibration | 3-24 |
| | 6. Schematics | 3-25 |
| | 7. Parts Provisioning List and Component Locations | 3-37 |
| Chapter | 4. PREVENTIVE MAINTENANCE AND MODIFICATION | |
| Section | 1. Preventive Maintenance Instructions | 4-1 |
| | 2. Modification | 4-4 |
| | 5. Repair Parts List | 5-1 |
| Appendix | A. REFERENCES | A-1 |
| | B. BASIC ISSUE ITEMS LIST AND TROOP INSTALLED OR AUTHORIZED LIST | B-1 |
| | C. MAINTENANCE ALLOCATION CHART | C-1 |

# Section 0
# INTRODUCTION

0.1. SCOPE

0.2. This manual includes installation and operation instructions and covers organizational, direct support (DS), and general support (GS) maintenance. It describes Ac Precision Power Supply, N. H. Research, Inc. Model SF 613-1.

0.3. The basic issue items list appears in Appendix B. Appendix B is current as of 24 March 1972.

0.4. INDEXES OF PUBLICATIONS

0.5. *DA Pam 310-4.* Refer to the latest issue of DA Pam 310-4 to determine if there are any new editions, changes, or additional publications pertaining to the equipment.

0.6. *DA Pam 310-7.* Refer to DA Pam 310-7 to determine whether there are Modification Work Orders (MWO's) pertaining to the equipment.

0.7. FORMS AND RECORDS

0.8. *Reports of Maintenance and Unsatisfactory Equipment.* Use equipment forms and records in accordance with instructions given in TM 38-750.

0.9. *Report of Packaging and Handling Deficiencies.* Fill out and forward DD Form 6 as prescribed in AR 700-58 (Army), NAVSUP Pub 378 (Navy), AFR 71-4 (Air Force), and MCO P4030.29 (Marine Corps).

0.10. *Discrepancy in Shipment Report.* Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38 (Army), NAVSUP Pub 459 (Navy), AFM 75-34 (Air Force), and MCO P3610.19 (Marine Corps).

CHAPTER I

SF 613-1 EXCITER UNIT (LESS OSCILLATOR ASSEMBLY)

Section 1

SPECIFICATIONS

GENERAL PURPOSE SINE WAVE AC POWER SOURCE

| | |
|---|---|
| Output Frequency Range: | 10Hz - 100KHz |
| Frequency Resolution: | Three digits above 100Hz (two digits 10Hz - 99Hz) with decimal ranging and vernier. |
| Frequency Accuracy: | ±1.0% of setting |
| Output Power: | 200 Watts at the following matched power points: |

| | |
|---|---|
| 1200V | (7200 ohms) |
| 600V | (1800 ohms) |
| 300V | ( 450 ohms) |
| 120V | ( 72 ohms) |
| 60V | ( 18 ohms) |
| 30V | ( 4.5 ohms) |
| 12V | ( .72 ohms) |

| | |
|---|---|
| Full Power Frequency Bandwidth: | 45Hz to 40KHz |
| Output Voltage with 100 ohm/V load: | 0 - 1500 volts minimum 60 - 50KHz<br>0 - 1000 volts minimum, from 35Hz up. |
| Voltage Ranging: | taps at 1500V<br>800V<br>400V<br>160V<br>80V<br>40V<br>15V |

| | |
|---|---|
| Voltage Controls: | Five digit ratio transformer, plus a decade voltage attenuator and ten-turn vernier. |
| VOLTAGE STABILITY,* (after 2½ hr. warmup): | |
| Vs. line: | ±0.01% for 115V ±10V line |
| Vs. time: ** | ±20 ppm/2 minutes<br>±50 ppm/hr. |

*Measurements made with an average sensing voltmeter at midband ** and constant temperature.

| | |
|---|---|
| Load Regulation: | Adjustable by front panel control. |
| Distortion: | 0.05% max THD, 50 Hz to 10KHz, degrading to 1% at 100KHz. |
| Residual Hum and Noise: | -86 db |

CONSTANT CURRENT MODE:

| | | | |
|---|---|---|---|
| Current Ranges | 18A | into | 0.18 ohm or less |
| | 7.2A | into | 1.125 ohm or less |
| | 3.6A | into | 4.5 ohm or less |
| | 1.8A | into | 18 ohm or less |
| | .72A | into | 112.5 ohm or less |
| | .36A | into | 450 ohm or less |
| | .18A | into | 1800 ohm or less |

| | |
|---|---|
| Current Regulation: | Adjustable by front panel control. |
| Overvoltage/Overcurrent Protection: | Automatic with manual reset. |
| On/Standby Switch: | Front panel control allows output to be turned off without turning off primary power. |
| Construction: | All silicon solid state except for power output stages. |

| | |
|---|---|
| Line Power: | 115V ±10V, 60 Hz |
| Metering: | Front panel mounted to monitor either output voltage or current. |
| Physical: | Two standard 19" rack panels<br>15-3/4" total height<br>18" deep<br>135 lbs. approximately. |

## SECTION 2 OPERATING INSTRUCTIONS

### 2.0 CONTROLS

2.1 Frequency Select Switches: The frequency control section of this unit consists of three decade switches which work in conjunction with a three-position frequency range switch. The range switch also incorporates a 270° potentiometer as a frequency vernier.

2.2 Attenuation Control: This is a decade switch with a 10 turn potentiometer control, used for adjusting the signal level from the oscillator section of the exciter to the ratio transformer section.

2.3 Voltage Switches: This section consists of five decade switches which are the controls for the ratio transformer section of this instrument.

2.4 R/T Output: These are front panel 5-way binding posts provided for measurement of the ratio transformer input and voltage at TP4 and TP5 and output voltage at TP5 and TP6.

2.5 Fuses: This instrument requires a 0.4 amp slo-blow fuse located on the rear of the chassis.

### 2.2 INSTALLATION

2.2.1 Mounting: This unit may be mounted in a standard RETMA 19" rack panel or may be used as a bench instrument.

2.2.2 Line Power: The exciter requires 105 to 125V, 60 Hz.

2.2.3 Output: A BNC connector is provided on the rear of the chassis for signal output. This output is utilized as the signal input to the SF 613-1 amplifier.

2.2.4 Grounding: The low side of the instrument output is common to system and chassis ground.

## SECTION 3 THEORY OF OPERATION

3.0 Introduction: The exciter unit portion of the SF 613-1 system is designed to provide variable frequency, variable voltage excitation to the power unit.

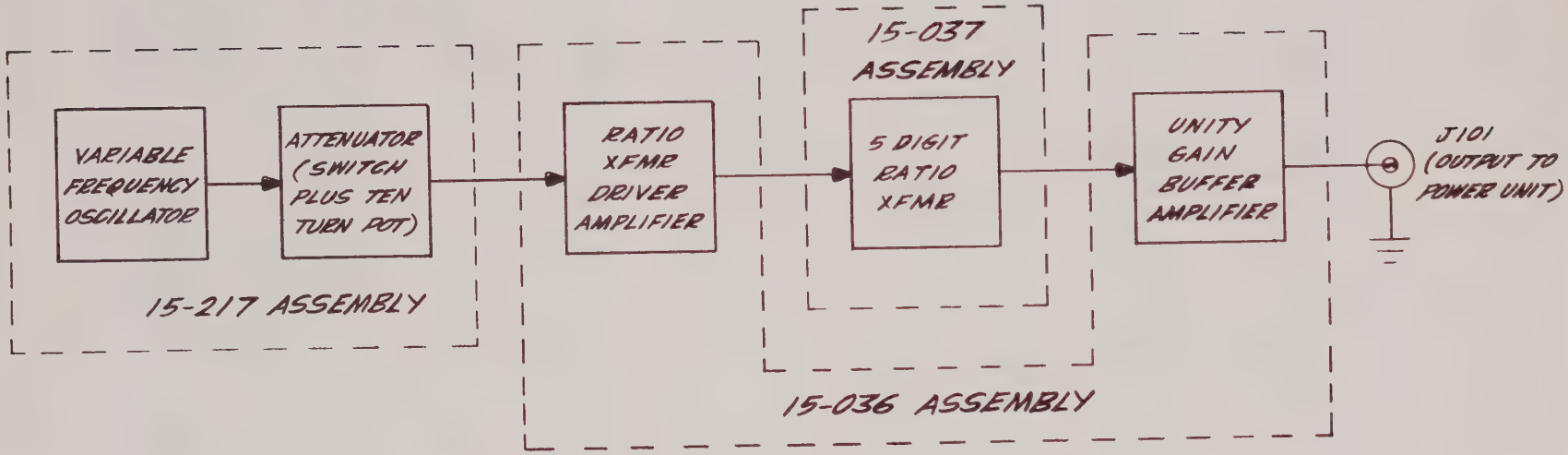
3.1 Block Diagram: Refer to Figure 3.1. The variable frequency oscillator generates a constant 10V RMS signal into the attenuator. The attenuator uses a switch with a ten-turn wirewound potentiometer to interpolate the voltage between switch positions with high resolution and stability. The voltage at the output of the attenuator can range from 0 to 10V RMS. The ratio transformer driver amplifier is an inverting operational amplifier with a gain of 0.3 over most of the frequency range (see par. 3.4). Thus, the maximum input voltage to the ratio transformer is about 3V RMS. The ratio transformer provides accurate scaling of the output voltage for linearity measurements. The unity gain buffer amplifier presents a high impedance to the ratio transformer output while driving the input impedance of the power unit. The maximum output voltage at J101, with all controls at maximum is about 3V RMS.

3.2 Oscillator: The oscillator (15-217 assembly) is a KROHN-HITE Model 4000R-7 oscillator which is documented separately. The oscillator manual is attached as part 2 of this manual.

3.3 Ratio Transformer: The 5 digit ratio transformer (15-037 assembly) provides precise attenuation increments, so that the output of the SF 613-1 system may be used to test the linearity of a device (such as an AC VTVM). This ratio transformer is wound on Supermalloy toroidal cores, and is an 0.05F unit. This means that the maximum input voltage to the transformer is 50 millivolts multiplied by the frequency in Hertz. For instance, at 10Hz the maximum input voltage is half a volt, while at 35Hz the maximum input is 1.75V. If this voltage-frequency rating is exceeded, the transformer core material will saturate.

3.4 Driver Amplifier: The ratio transformer driver amplifier is an operational amplifier having a voltage gain of 0.3 except at low frequencies, where the response is deliberately rolled off to avoid the core saturation effect described in Par. 3.3. This rolloff is accomplished via the C 901 - R 901 time constant. The response is 3 db down at 60 Hz and rolls off at 6 db/octave below 60 Hz. A dual feedback path is used around this operational amplifier. R 911 and R 915 supply the DC feedback path needed to stabilize the collector voltage of Q 905 at approximately +10V DC. R 910 supplies the principal AC feedback path, taken directly from the input of the ratio transformer to provide low distortion and a low output impedance as seen by the transformer. Q 901, 902, and 905 form a conventional inverting triplet. Q 901 is a field-effect transistor, to minimize the low-frequency noise typical of conventional (bipolar) transistors. Q 904 is a constant current source, acting as a high impedance collector load for Q 905. Q 903 limits the maximum current in Q 905 during turn-on and transient conditions.

3.5 Buffer Amplifier: The unity gain buffer amplifier presents a high impedance load to the ratio transformer while driving the input resistance of the power unit (about 10K ohms) and the capacity of the connecting cable. Q 906 and 909 form a non-inverting feedback pair, with the feedback returned to the source of Q 906, a field-effect transistor. Q 907 and CR 903 maintain the source-drain voltage of Q 906 to a constant value (about +7V DC), even under signal conditions. This bootstrapping effect reduces the distortion generated in the buffer amplifier to a negligible amount. Q 908 is a constant current source, providing a high impedance collector load for Q 906.




BLOCK DIAGRAM, SF613-1 EXCITER UNIT



FIG. 3.1

## SECTION 4 MAINTENANCE

4.0 The oscillator section of this unit is a Krohn-Hite Series 4000. All maintenance requirements are referred to in the Krohn-Hite Operating and Maintenance manual in Part 2 of this manual.

4.1 The ratio transformer used in this instrument requires a minimum amount of maintenance. Every six months to one year, clean the switch contacts with a good grade of solvent such as alcohol or acetone.

4.2 Troubleshooting: In the event of apparent malfunction of the exciter unit, the trouble must first be isolated to the oscillator, ratio transformer, or ratio transformer driver and buffer amplifier assemblies. The following troubleshooting procedure is best accomplished with the exciter unit disconnected from the power unit, and operated independently.

4.2.1 Frequency Problems: Since the oscillator section of the exciter unit determines the output frequency, any frequency malfunctions are almost certain to be in the oscillator subassembly, and reference should be made to the maintenance section of the oscillator manual attached as Part 2 of this manual.

4.2.2 Voltage Problems: Since all three of the subassemblies affect the output voltage, we must first isolate the difficulty to the appropriate subassembly. First, the attenuator switch and potentiometer on the lower left of the front panel should be rotated to their maximum clockwise positions. The oscillator frequency should be set at about 1 KHz. The oscillator subassembly output voltage should now be approximately 10VRMS or 28V peak to peak. This voltage can be located at C901, the input to the 15-036 assembly (the photograph in Section 7 of this manual will assist in locating C901). If the voltage is not present at C901, the trouble has been isolated to the oscillator subassembly and reference is made to the maintenance section of the oscillator manual, attached as Part 2 of this manual. If the voltage is present, the trouble is in either the ratio transformer subassembly or in the associated 15-036 amplifier assembly (see Fig. 3.1 in Section 3 for a signal flow block diagram).

4.2.2 Continued. . . .

Assuming 10VRMS is present at C901, approximately 3VRMS or 8.5V peak to peak should be present at TP4 on the front panel, the ratio transformer input. If this voltage is not present, the trouble has been isolated to the first section of the 15-036 assembly, and reference should be made to paragraph 4.3.1. If the proper voltage is present at TP4, the five ratio transformer switches should be dialed to 99999. The ratio transformer output voltage at TP6 should be essentially the same as at TP5, 3VRMS or 8.5V peak to peak. If this voltage is absent, the trouble has been isolated to the ratio transformer assembly. If the voltage is present at TP6, the buffer amplifier portion of the 15-036 assembly is the remaining possible source of difficulty. With the 3VRMS signal present at TP6, the same voltage should be present at J101 on the rear panel of the exciter unit. If this voltage is not present, the trouble has been isolated to the second section of the 15-036 assembly, and reference should be made to paragraph 4.3.2. In the event that the exciter unit and the power unit each function properly when tested separately, yet don't work together, attention should be given to the cable connecting J101 of the exciter unit to J201 of the power unit.

4.3 15-036 Assembly: This assembly includes the 14-023 circuit boards and the components mounted thereon. This circuit board is mounted behind the ratio transformer assembly. This assembly requires +25, +20 and -20 DC supplies for operation, which are obtained from the oscillator assembly. The 15-036 assembly may be functionally divided into two portions, the ratio transformer driver amplifier and the buffer amplifier.

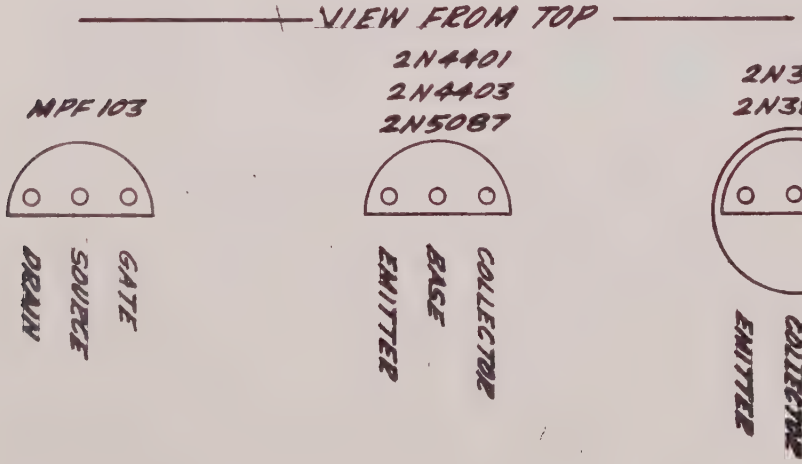
4.3.1 Ratio Transformer Driver Amplifier: This inverting operational amplifier may be tested most easily by checking the DC level on the positive terminals of C907 and C908, the large capacitors in the middle of the 14-126 board. This voltage is normally about +10VDC ±2V. If this amplifier is defective, it is likely that this voltage will be either over +20VDC or less than +1VDC. Table 4-1 provides nominal DC levels for a properly functioning assembly to assist more detailed trouble-shooting.

4.3.2 Buffer Amplifier: This non-inverting feedback amplifier may be tested most easily by checking the DC output level at J101. This voltage will normally be slightly positive, with a normal range between +0.3V and +2.0VDC. This voltage corresponds to the bias point of Q906, a field-effect transistor. If this amplifier is defective, it is likely that this voltage will either be slightly negative or more positive than +5VDC. Table 4-1 provides nominal DC levels for a properly functioning assembly to assist more detailed troubleshooting.

# TABLE 4-1

| REF # | EMITTER OR * SOURCE | BASE OR * GATE | COLLECTOR OR * DRAIN |
|---|---|---|---|
| * Q901 | 0V<br>——— | +0.75<br>+0.25 TO +2 | +7<br>+6 TO +8 |
| Q902 | +7.5<br>+6.5 TO 7.5 | +7<br>+6 TO +8 | +0.9<br>+0.6 TO +1.2 |
| Q903 | 0V<br>——— | +0.3<br>+0.15 TO +0.5 | +0.9<br>+0.6 TO +1.2 |
| Q904 | +20.5<br>+18.5 TO +22.5 | +20<br>+18 TO +22 | +10<br>+8 TO +12 |
| Q905 | +0.3<br>+0.15 TO +0.5 | +0.9<br>+0.6 TO +1.2 | +10<br>+8 TO +12 |
| * Q906 | +0.75<br>+0.25 TO +2 | 0V<br>——— | +7.5<br>+6 TO +9 |
| Q907 | +7.5<br>+6 TO +9 | +8<br>+6 TO +10 | +19.5<br>+17.5 TO +21.5 |
| Q908 | -7.5<br>-6 TO -9 | -7<br>-5.5 TO -8.5 | +0.75<br>+0.25 TO +2 |
| Q909 | +20<br>+18 TO +22 | +19.5<br>+17.5 TO +21.5 | +8<br>+6 TO +10 |

NOTES: For each transistor, the first line provides a nominal voltage, while the second line indicates the normal range of variation due to component tolerances, etc. The voltages must be measured with an instrument having an input impedance of 1 meg ohm or greater, such as a VTVM.



SECTION 5 MAINTENANCE CALIBRATION [1]

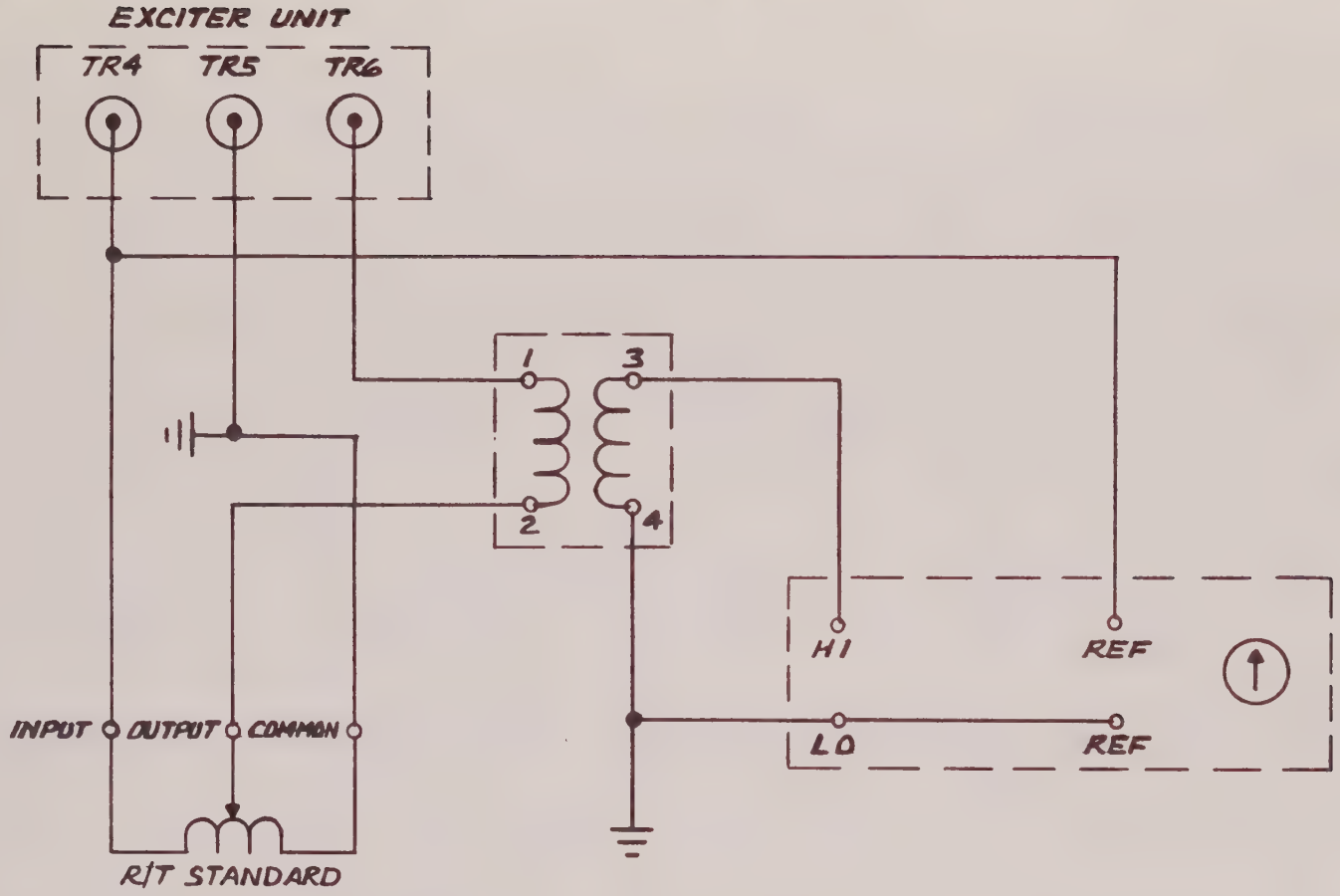
5.0 The oscillator section of this unit is a Krohn-Hite series 4000. All calibration procecures are referred to in the Krohn-Hite Operating and Maintenance Manual in Part 2.

5.1 Under normal laboratory environment, the ratio transformer section should only require calibration every three years. The following test can be performen at this interval.

Ratio Accuracy Test:

1. Disconnect the exciter output from the power unit and connect the exciter unit as shown in Figure 5.1.
2. Set the frequency to 1K Hz using the exciter unit as the signal source.
3. Apply input voltage of 3 VAC (full output).
4. Set RT standard controls for an output reading of .11111.
5. Adjust the unit under test until the null indicator indicates a null.
6. Check the ratio indicated by the unit under test against the ratio indicated by the RT standard unit. The two ratios shall agree within ± .01% of the setting.
7. Repeat step 5 through 6 for each switch position of the RT standard unit such as .22222, .33333 etc., through .99999.

[1] This procedure is to be used only in maintenance. For calibration procedure, see TB 750-236.




BLOCK DIAGRAM - RATIO ACCURACY TEST



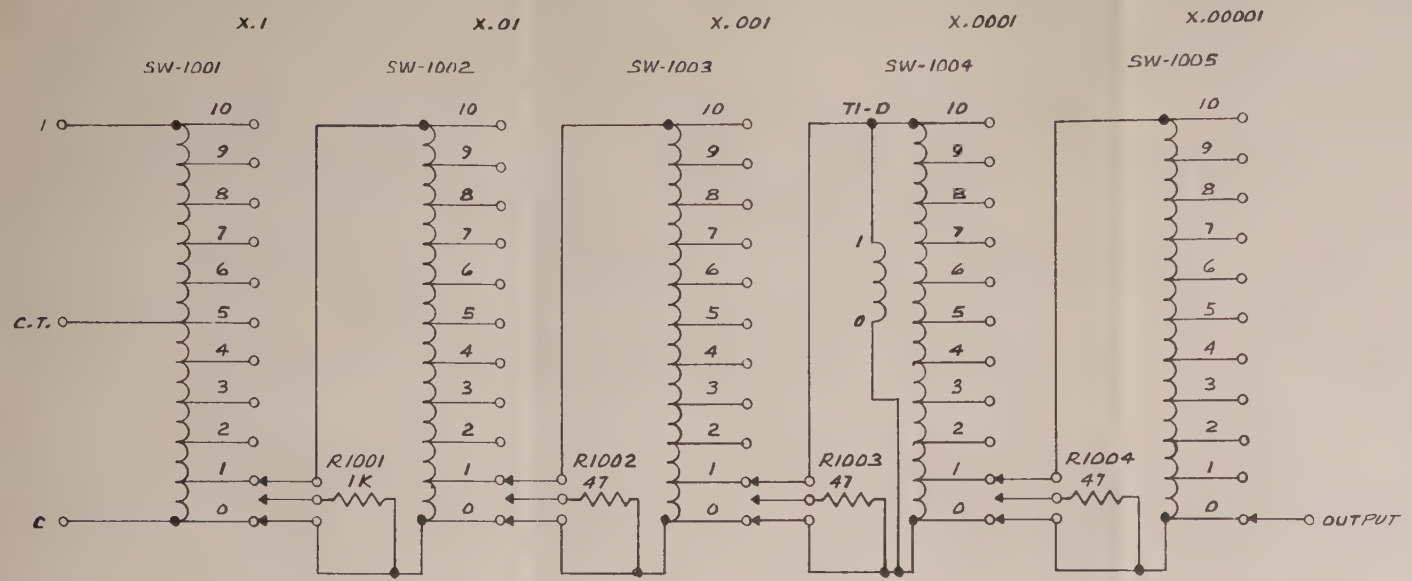
FIG. 5.1

EQUIPMENT REQUIRED FOR RATIO ACCURACY TEST

| NOMENCLATURE | PART NUMBER OR MODEL | APPLICATION | RANGE | ACCURACY |
|---|---|---|---|---|
| AC Ratio Standard | Model 1011 (Singer Metrics) | Provides comparison standard for ratio test | 1.111111 to -0.111111 ratios | Per National Bureau of Standards Calibration Test |
| Isolation Transformer | Model ST248 (Singer Metrics) | Provides signal isolation | 120 vac, 400 Hz (maximum) | |
| Null Indicator | Model NI-3 (Singer Metrics) | Provides means of comparing output voltage | | |

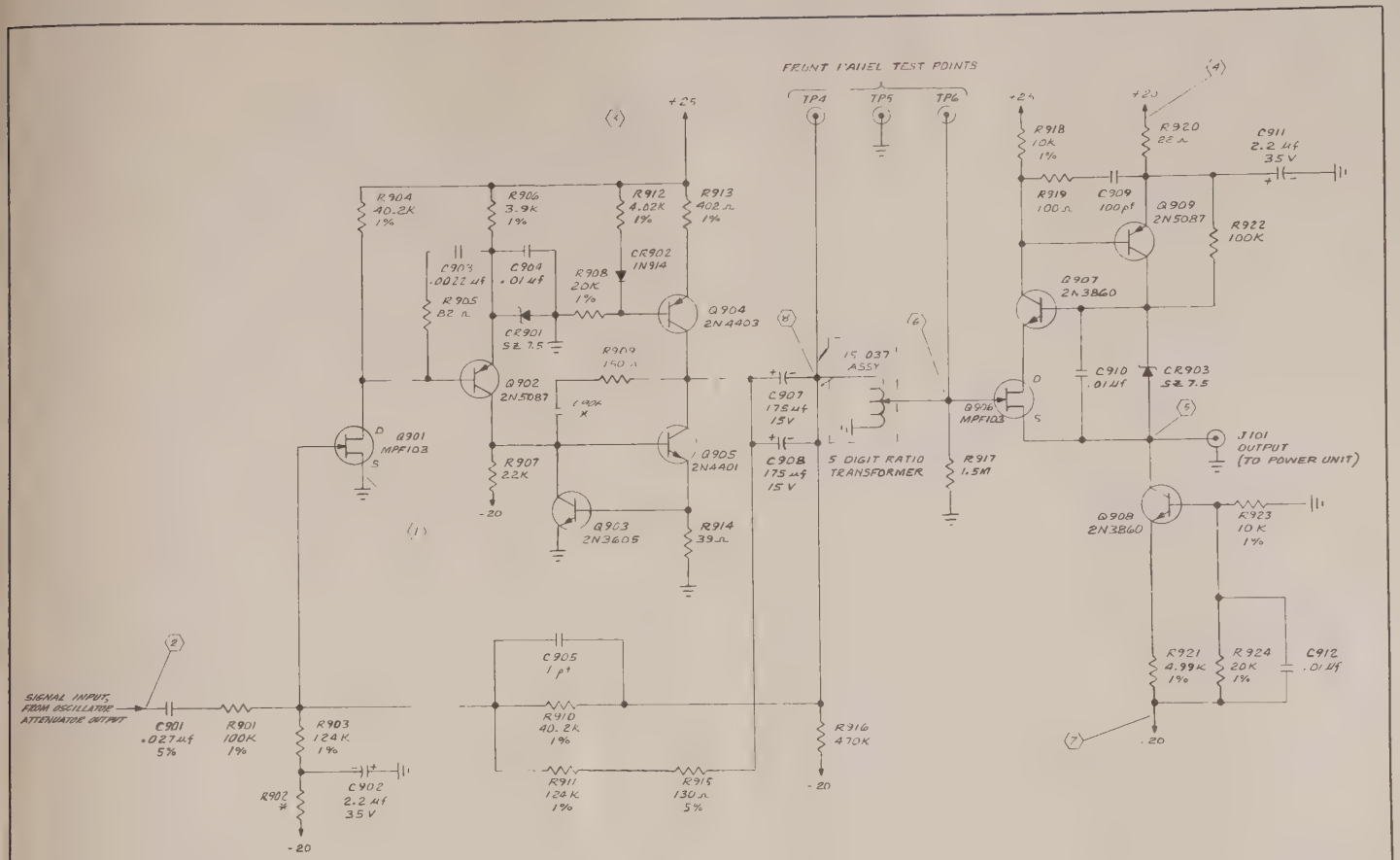
TABLE 5-1

# SECTION 6. SCHEMATICS




| | | |
|---|---|---|
| SCALE: | APPROVED BY: | DRAWN BY L.M. |
| DATE: 28 OCT 65 | | REVISED |
| RATIO TRANSFORMER ASSY | | |
| N H RESEARCH, INC. SANTA ANA, CALIF. | | DRAWING NUMBER 10-723 |

11X17 PRINTED ON NO. 1000H-10 CLEARPRINT FADE-OUT




3. NUMBERS MARKED ⬡ REFER TO TERMINALS ON THE 14-123 CIRCUIT BOARD

2. COMPONENTS NUMBERED BETWEEN 900 & 999 ARE LOCATED ON THE 14-123 CIRCUIT BOARD AND COMPRISE THE 15-036 ASSY.

1. * INDICATES FACTORY SELECTED VALUE. C906.

NOTES:

| | | |
|---|---|---|
| SCALE | APPROVED BY: | DRAWN BY: L. Hoisan |
| DATE 10-20-68 | | REVISED |

SF613-1 BUFFER AMPLIFIER

N H RESEARCH, INC. SANTA ANA, CALIF.

DRAWING NUMBER 10-683

## RESISTORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R101 | 0.82 | 5% | 1W | IRC | AS-1 |
| R102 | 470 | 10% | 1/2W | A-B | EB-4711 |
| R103 | 100 | 20% | 1/2W | A-B | EB-1012 |
| R104 | 2.2K | 10% | 1/2W | A-B | EB-2221 |
| R105 | 120 | 10% | 1/2W | A-B | EB-1211 |
| R106 | 100 | 20% | 1/2W | A-B | EB-1012 |
| R107 | 2.2K | 10% | 1/2W | A-B | EB-2221 |
| R108 | 15K | 10% | 1/2W | A-B | EB-1531 |
| R109 | 18K | 10% | 1/2W | A-B | EB-1831 |
| R110 | 2.4K | 5% | 1/2W | A-B | EB-2425 |
| R111 | 33K | 10% | 1/2W | A-B | EB-3331 |
| R112 | 33K | 10% | 1/2W | A-B | EB-3331 |
| R113 | 4.99K | 1% | 1/2W | IRC | CEC-TO |
| R114 | 8.25K | 1% | 1/2W | IRC | CEC-TO |
| R115 | Trim | 20% | 1/2W | A-B | TYPE EB |
| R116 | 12K | 10% | 1/2W | A-B | EB-1231 |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R117 | 510 | 5% | 1/2W | A-B | EB-5115 |
| R118 | 1.2K | 10% | 1/2W | A-B | EB-1221 |
| R119 | 2 | 5% | 1W | IRC | AS-1 |
| R120 | 15 | 5% | 2W | A-B | HB-1505 |
| R121 | 10K | 1% | 1/2W | IRC | CEC-TO |
| R122 | 10K | 1% | 1/2W | IRC | CEC-TO |
| R123 | 1.5K | 5% | 1/2W | A-B | EB-1525 |
| R124 | 470 | 10% | 1/2W | A-B | EB-4711 |
| R125 | 0.82 | 5% | 1W | IRC | AS-1 |
| R126 | 6.8K | 10% | 1/2W | A-B | EB-6821 |
| R127 | 100 | 20% | 1/2W | A-B | EB-1012 |
| R128 | 2.7K | 10% | 1/2W | A-B | EB-2721 |
| R129 | 220 | 10% | 1/2W | A-B | EB-2211 |
| R130 | 10K | 10% | 1/2W | A-B | EB-1031 |
| R131 | 12.4K | 1% | 1/2W | IRC | CEC-TO |
| R132 | 10K | 1% | 1/2W | IRC | CEC-TO |

## CAPACITORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C101 | 0.0047mf | 10% | 100V | C-D | WMF-1D47 |
| C102 | 4mf | +75% -10% | 50V | SP | 30D405G050 BA2 |
| C103 | 4mf | +75% -10% | 50V | SP | 30D405G050 BA2 |
| C104 | 4mf | +75% -10% | 50V | SP | 30D405G050 BA2 |
| C105 | 20mf | +75% -10% | 50V | SP | 30D206G050 CC2 |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C106 | 15mf | 20% | 50V | SP | 150D156X0050 R2 |
| C107 | 20mf | +75% -10% | 50V | SP | 30D206G050 CC2 |
| C108 | 0.0022mf | 10% | 100V | C-D | WMF-1D22 |
| C109 | 4mf | +75% -10% | 50V | SP | 30D405G050 BA2 |
| C110 | 15mf | 20% | 50V | SP | 150D156X0050 R2 |

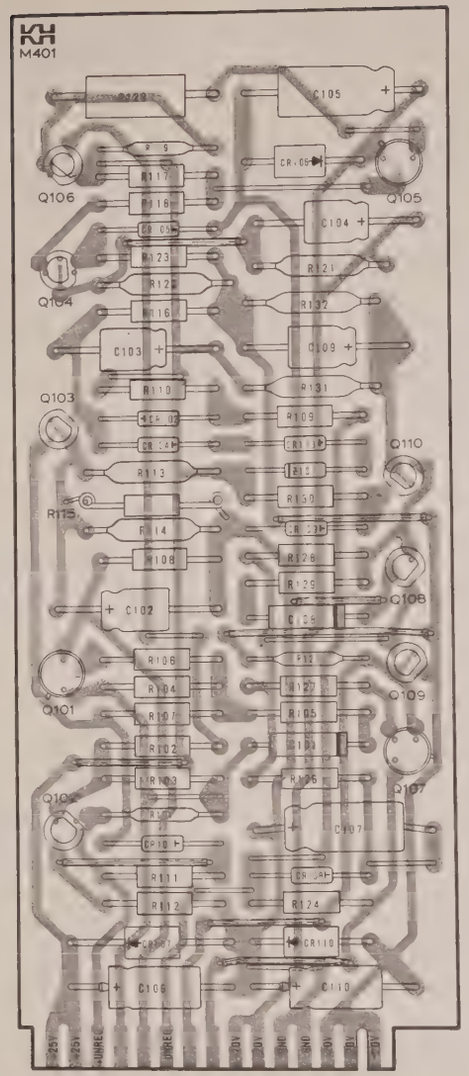
## TRANSISTORS, DIODES, & MISC.

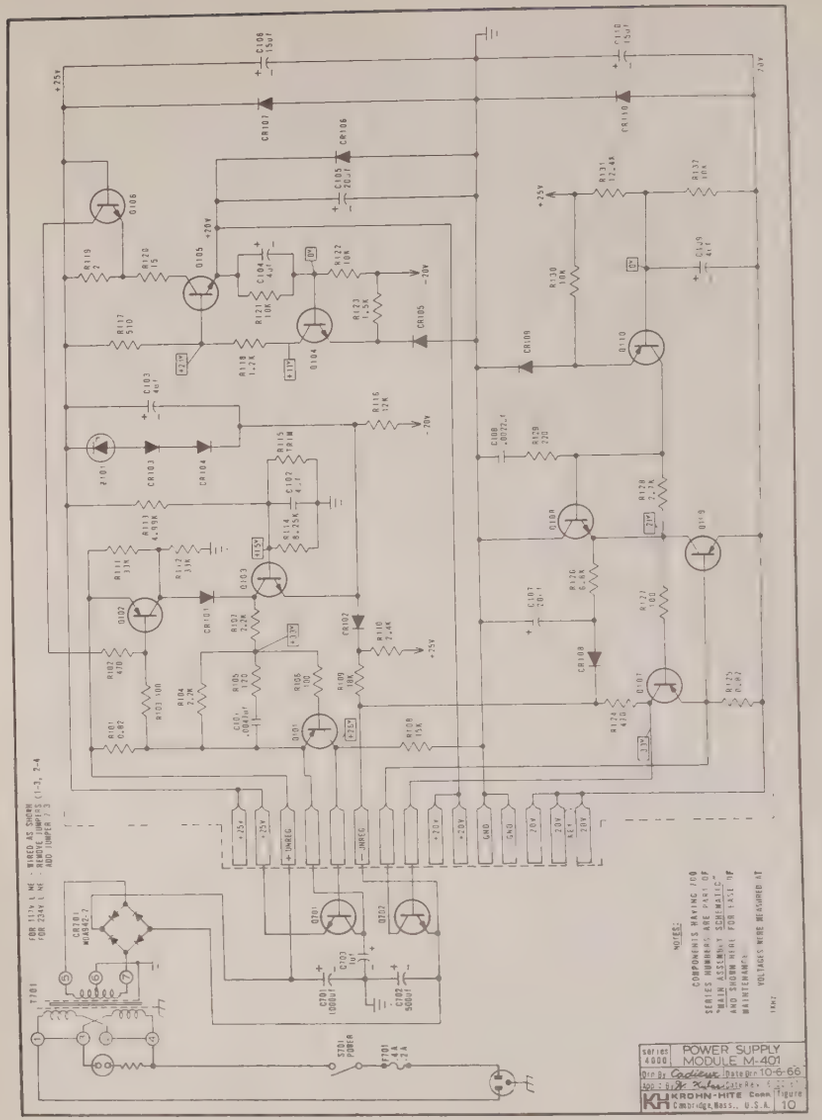
| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q101 | 40319 | RCA | 40319 |
| Q102 | 2N3703 | TI | 2N3703 |
| Q103 | 2N3708 | TI | 2N3708 |
| Q104 | 2N3711 | TI | 2N3711 |
| Q105 | 40315 | RCA | 40315 |
| Q106 | 2N3416 | GE | 2N3416 |
| Q107 | 40319 | RCA | 40319 |
| Q108 | 2N3711 | TI | 2N3711 |
| Q109 | 2N3703 | TI | 2N3703 |
| Q110 | 2N3702 | TI | 2N3702 |
| CR101 | 1N456 | TRANS | 1N456 |

| Symbol | Description | Mfr | Part No. |
|---|---|---|---|
| CR102 | 1N456 | TRANS | 1N456 |
| CR103 | 1N456 | TRANS | 1N456 |
| CR104 | 1N456 | TRANS | 1N456 |
| CR105 | 1N456 | TRANS | 1N456 |
| CR106 | 1N3253 | RCA | 1N3253 |
| CR107 | 1N3253 | RCA | 1N3253 |
| CR108 | 1N456 | TRANS | 1N456 |
| CR109 | 1N456 | TRANS | 1N456 |
| CR110 | 1N3253 | RCA | 1N3253 |
| Z101 | 1N935 | SEM | 1N935 |

## MANUFACTURERS CODE

| | | | | | |
|---|---|---|---|---|---|
| A-B | Allen-Bradley Co. | Milwaukee, Wis. | SEM | U.S. Semcor | Phoenix, Ariz. |
| C-D | Cornell-Dubilier Elec. | Newark, N.J. | SP | Sprague Electric Co. | North Adams, Mass. |
| GE | General Electric Co. | Syracuse, N.Y. | TI | Texas Instruments, Inc. | Dallas, Texas |
| IRC | International Resistance Co. | Philadelphia, Pa. | TRANS | Transitron Electric Corp. | Wakefield, Mass. |
| RCA | Radio Corp. of America | Harrison, N.J. | | | |



## RESISTORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R401 | 1K | 10% | 1/2W | A-B | EB-1021 |
| R402 | 100K | 5% | 1/4W | A-B | CB-1045 |
| R403 | 2.98K | 0.1% | 1/2W | IRC | CEC-TO |
| R404 | 2.98K | 0.1% | 1/2W | IRC | CEC-TO |
| R405 | 75K | 5% | 1/2W | A-B | EB-7535 |
| R406 | 18K | 5% | 1/2W | A-B | EB-1835 |
| R407 | 1K | 10% | 1/2W | A-B | EB-1021 |
| R408 | 3.6K | 5% | 1/2W | A-B | EB-3625 |
| R409 | 910 | 5% | 1/2W | A-B | EB-9115 |
| R410 | 2.7K | 10% | 1/2W | A-B | EB-2721 |
| R411 | 15 | 5% | 1/2W | A-B | EB-1505 |
| R412 | Trim | | | A-B | TYPE EB |
| R413 | Trim | | | A-B | TYPE EB |
| R414 | 680 | 5% | 1/2W | A-B | EB-6815 |
| R415 | 14.7K | 1% | 1/2W | IRC | CEC-TO |
| R416 | 14.7K | 1% | 1/2W | IRC | CEC-TO |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R417 | 62 | 5% | 1/2W | A-B | EB-6205 |
| R418 | 62 | 5% | 1/2W | A-B | EB-6205 |
| R419 | 270 | 10% | 1/2W | A-B | EB-2711 |
| R420 | 10 | 5% | 1/2W | A-B | EB-1005 |
| R421 | 10 | 5% | 1/2W | A-B | EB-1005 |
| R422 | 100 | 20% | 1/4W | A-B | CB-1012 |
| R423 | 15K | 5% | 1/2W | A-B | EB-1535 |
| R424 | 6.2K | 5% | 1/2W | A-B | EB-6225 |
| R425 | 3.9K | 5% | 1/2W | A-B | EB-3925 |
| R426 | 100 | 10% | 1/2W | A-B | EB-1011 |
| R427 | 10K | 5% | 1/2W | A-B | EB-1035 |
| R428 | 10K | 5% | 1/2W | A-B | EB-1035 |
| R429 | 2.4K | 5% | 1/2W | A-B | EB-2425 |
| R430 | 2K | 5% | 1/2W | A-B | EB-2025 |
| R431 | 15 | 5% | 1/2W | A-B | EB-1505 |
| R432 | 91K | 5% | 1/2W | A-B | EB-9135 |

## CAPACITORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C401 | 1mfd | 20% | 35V | SP | 150D105X0035A2 |
| C402 | 1mfd | 20% | 35V | SP | 150D105X0035A2 |
| C403 | 33pf | 5% | 500V | EL | DM15C330J |
| C404 | 15pf | 5% | 500V | EL | DM15C150J |
| C405 | 24pf | 10% | 500V | EL | DM15C240K |
| C406 | 0.001mfd | 10% | 400V | C-D | WMF1D1 |
| C407 | 24pf | 10% | 500V | EL | DM15C240K |

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C408 | 1mfd | 20% | 35V | SP | 150D105X0035A2 |
| C409 | 1mfd | 20% | 35V | SP | 150D105X0035A2 |
| C410 | 0.01mfd | 10% | 100V | C-D | WMF1S1 |
| C411 | 1mfd | 20% | 35V | SP | 150D105X0035A2 |
| C412 | 10pf | 10% | 500V | EL | DM15C100K |
| C413 | 0.01mfd | 10% | 100V | C-D | WMF1S1 |

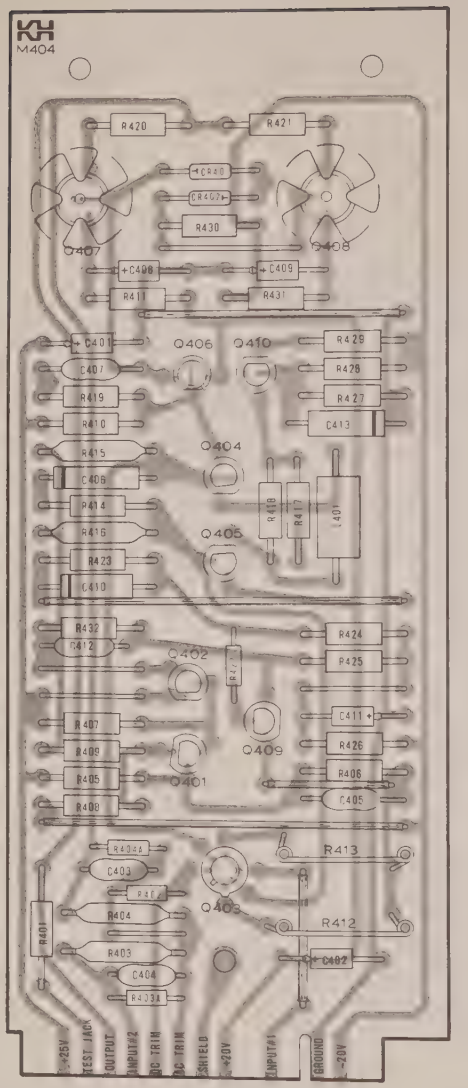
## TRANSISTORS, DIODES, & MISC.

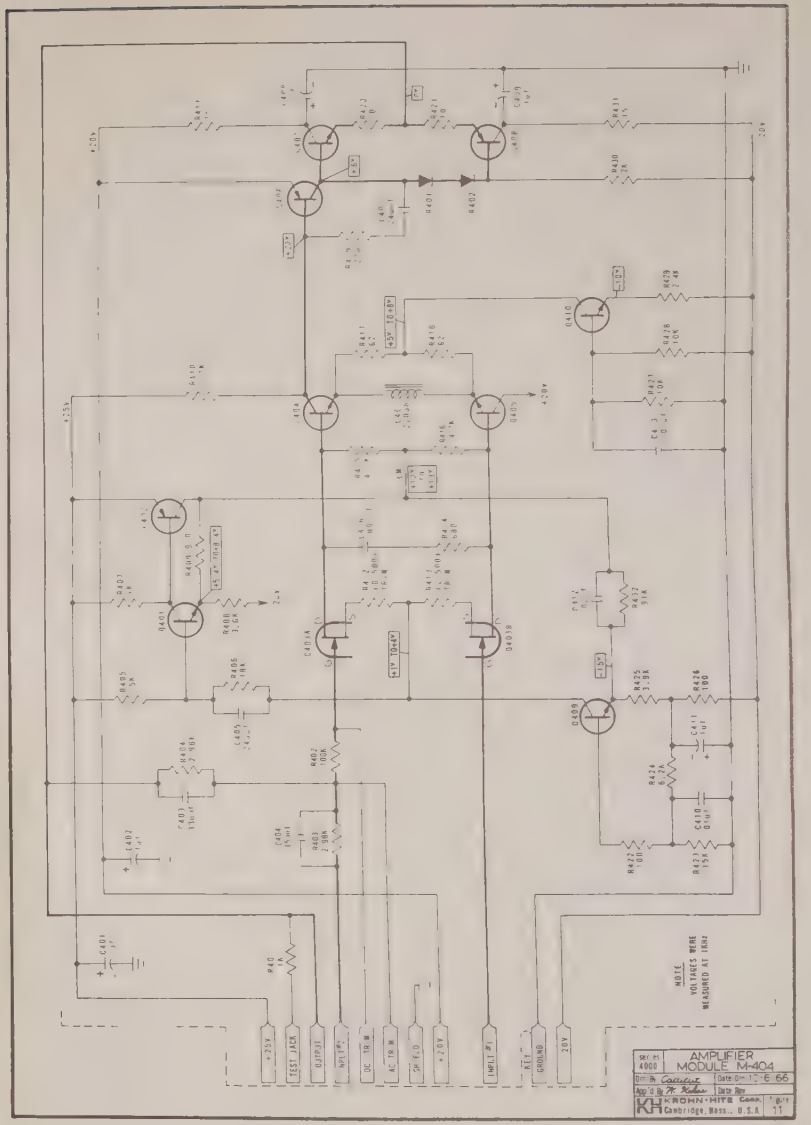
| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q401 | 2N3711 | TI | 2N3711 |
| Q402 | 2N3703 | TI | 2N3703 |
| Q403 | FD1070 | UC | FD1070 |
| Q404 | 2N3711 | TI | 2N3711 |
| Q405 | 2N3711 | TI | 2N3711 |
| Q406 | MM2005-2 | MOT | MM2005-2 |
| Q407 | 2N1711 | RCA | 2N1711 |

| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q408 | 40319 | RCA | 40319 |
| Q409 | 2N3903 | MOT | 2N3903 |
| Q410 | 2N3708 | TI | 2N3708 |
| CR401 | 1N456 | TRANS | 1N456 |
| CR402 | 1N456 | TRANS | 1N456 |
| L401 | 220 uh | DEL | 3500-16 |

## MANUFACTURERS CODE

| | | | | | |
|---|---|---|---|---|---|
| A-B | Allen-Bradley Co. | Milwaukee, Wis. | SP | Sprague Electric Co. | North Adams, Mass. |
| C-D | Cornell-Dubilier Elec. | Newark, N. J. | TI | Texas Instruments, Inc. | Dallas, Texas |
| DEL | Delevan Electronics | East Aurora, N. Y. | TRANS | Transitron Electric Corp. | Wakefield, Mass. |
| EL | Electro Motive Mfg. Inc. | Willimantic, Conn. | MOT | Motorola Semiconductor | Phoenix, Arizona |
| IRC | International Resistance Co. | Philadelphia, Pa. | UC | Union Carbide Electronics | Mountain View, Calif. |
| RCA | Radio Corporation of America | Harrison, N. J. | | | |



## SECTION 7. PARTS PROVISIONING LIST AND COMPONENT LOCATIONS

### 7.0 REPLACEMENT PARTS

7.1 To obtain replacement parts, find the manufacturer's part number and description in this manual and then refer to the appropriate Repair Parts and Special Tools List (RPSTL) TM. In the RPSTL, find the assembly or subassembly first and then the description which corresponds with that in this manual. Under the description in the RPSTL find the manufacturer's part number, and then order the part by the listed Federal Stock Number. If the part is not listed in the RPSTL, it should be requisitioned from the NICP in accordance with AR 725-50.

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C901 | 0.027µf, ±5%, 100V Polystyrene | ARCO | 1PJ273J | 84171 | |
| C902 | 2.2µf, 35V, Electrolytic | KEMET | K2RZW35K | 05397 | |
| C903 | 0.0022µf, ±10%, 100V Mylar Film | C/D | WMF1D22 | 14655 | |
| C904 | 0.01µf, ±10%, 100V Mylar Film | C/D | WMF1S1 | 14655 | |
| C905 | 1 pf, ± .5 pf | ELMENCO | DM15010 | 84171 | |
| C906 | Selected Ceramic Disc Capacitor ±10%, 1000V | CENTRALAB | | 71590 | |
| C907 | 175µf, 15V, Electrolytic | MALLORY | TPG175T15 | 37942 | |
| C908 | 175µf, 15V Electrolytic | MALLORY | TPB175T15 | 37942 | |
| C909 | 100pf, ±10%, 1000V Ceramic Disc. | CENTRALAB | DD101 | 71590 | |
| C910 | 0.01µf, ±10%, 100V Mylar | C/D | WMF1S1 | 14655 | |
| C911 | 2.2µf, 35V, Electrolytic | KEMET | K2R2W35K | 05397 | |
| C912 | 0.01µf, ±10%, 100V Mylar | C/D | WMF1S1 | 14655 | |
| CR901 | Diode Zener, 7.5V, 10%, 1W | SCHAUER | SZ7.5 | 81071 | |
| CR902 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR903 | Diode Zener, 7.5V, 10%, 1W | SCHAUER | SZ7.5 | 81071 | |
| J101 | Output Connector | KINGS | KC-79-70 | 91836 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| Q901 | FET Transistor Silicon | MOTOROLA | MPF103 | 04713 | |
| Q902 | Transistor Silicon | MOTOROLA | 2N5087 | 04713 | |
| Q903 | Transistor Silicon | G.E. | 2N3605 | 03508 | |
| Q904 | Transistor Silicon | MOTOROLA | 2N4403 | 04713 | |
| Q905 | Transistor Silicon | MOTOROLA | 2N4401 | 04713 | |
| Q906 | FET Transistor Silicon | MOTOROLA | MPF103 | 04713 | |
| Q907 | Transistor Silicon | G.E. | 2N3860 | 03508 | |
| Q908 | Transistor Silicon | G.E. | 2N3860 | 03508 | |
| Q909 | Transistor Silicon | MOTOROLA | 2N5087 | 04713 | |
| R901 | 100K, 1/4W, 1% Metal Film | CORNING | NA60 | 07115 | |
| R902 | Selected, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R903 | 124K, 1/4W, 1% Metal Film | CORNING | NA60 | 07115 | |
| R904 | 40.2K, 1/4W, 1% Metal Film | CORNING | NA60 | 07115 | |
| R905 | 82 ohms, 1/2W, 10%, Carbon Comp. | OHMITE | RC20GF | 44655 | |
| R906 | 3.9K, 1/4W, 1% Metal Film | CORNING | NA60 | 07115 | |
| R907 | 22K, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R908 | 20K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R909 | 150 ohms, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R910 | 40.2K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R911 | 124K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R912 | 4.02K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R913 | 402 ohms, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R914 | 39 ohms, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R915 | 130 ohms, 1/2W, 5%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R916 | 470K, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R917 | 1.5M, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R918 | 10K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R919 | 100 ohms, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R920 | 22 ohms, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R921 | 4.99K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R922 | 100K, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R923 | 10K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R924 | 20K, 1/4W, 1%, Metal Film | CORNING | NA60 | 07115 | |
| R1001 | 2.2K ohms, 1/4W, ±10%, Carbon Comp | OHMITE | RC07 | 44655 | |
| R1002 | 47 ohms, 1/4W, ±10%, Carbon Comp | OHMITE | RC07 | 44655 | |
| R1003 | 47 ohms, 1/4W, ±10%, Carbon Comp. | OHMITE | RC07 | 44655 | |
| R1004 | 47 ohms, 1/4W, ±10%, Carbon Comp. | OHMITE | RC07 | 44655 | |
| SW1001 | Switch, Rotary Ceramic | Gertsch | SW126 | 88869 | |
| SW1002 | Switch, Rotary Ceramic | Gertsch | SW126 | 88869 | |
| SW1003 | Switch, Rotary Ceramic | Gertsch | SW126 | 88869 | |
| SW1004 | Switch, Rotary Ceramic | Gertsch | SW126 | 88869 | |
| SW1005 | Switch, Rotary Ceramic | Gertsch | SW126 | 88869 | |
| | | | | | |
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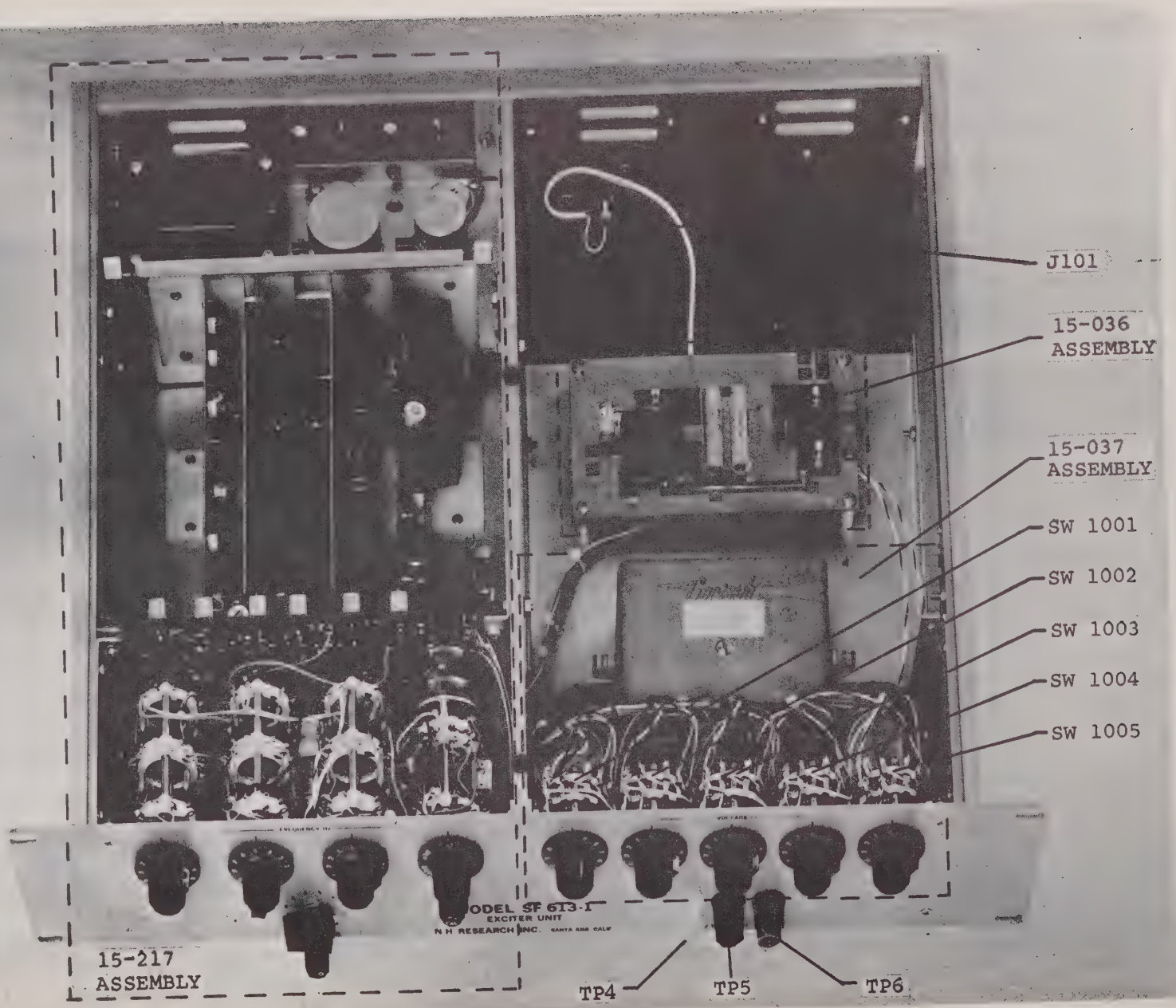
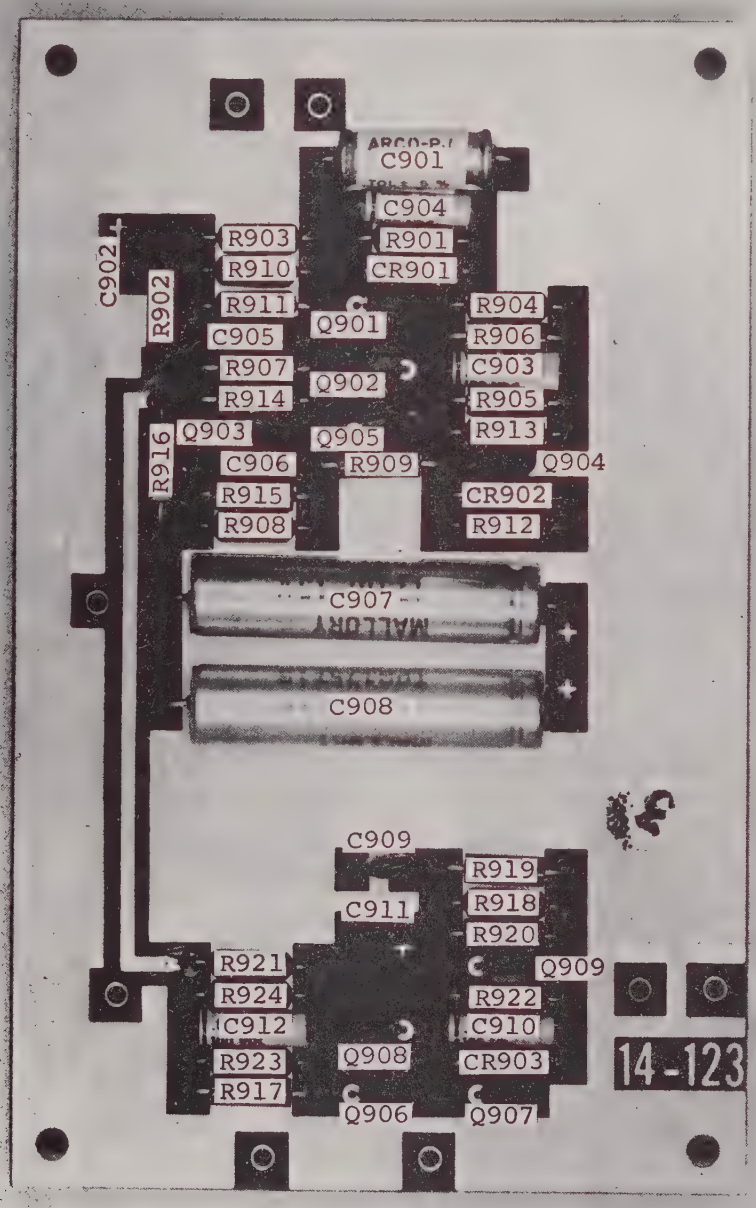

J101
15-036
ASSEMBLY
15-037
ASSEMBLY
SW 1001
SW 1002
SW 1003
SW 1004
SW 1005
MODEL SF 613-1
EXCITER UNIT
N H RESEARCH INC.
15-217
ASSEMBLY
TP4
TP5
TP6


C901
C904
R903
R901
R910
CR901
C902
R902
R911
Q901
R904
C905
R906
R907
Q902
C903
R914
R905
Q903
Q905
R913
R916
C906
R909
Q904
R915
CR902
R908
R912
C907
C908
C909
R919
C911
R918
R920
R921
Q909
R924
R922
C912
C910
R923
Q908
CR903
14-123
R917
Q906
Q907

CHAPTER 2

SF 613-1 OSCILLATOR ASSEMBLY (KROHN-HITE, MODEL 4000R-7)

# SECTION 1

# GENERAL DESCRIPTION

## 1.1 INTRODUCTION

This manual provides operation and maintenance instructions, with detailed specifications, schematic diagrams and parts lists, for the Krohn-Hite Series 4000 Oscillators. Differences between Models in this Series are briefly outlined in Table 1 below, and are fully detailed in the Technical Summary (paragraph 1.3). Component differences between Models are reflected in the Parts Lists included with the Schematic Diagrams at the end of this manual.

TABLE 1 - Summary of Basic Model Differences

| | Model 4000 |
|---|---|
| Frequency range | 0.1 Hz - 100 kHz |
| Main sine wave output control | one volt steps plus vernier |
| Main sine wave amplitude accuracy | ± 2% |
| Quadrature sine wave output control | fixed, 10v rms |

Note: For rack mounting, add suffix "R" to Model number.

## 1.2 DESCRIPTION

The Series 4000 Oscillators are designed for applications in the frequency range from 0.001 Hz to 100 kHz. All models provide simultaneously Main and Quadrature sine wave output of 10 volts rms maximum at 200 or 600 ohm impedance level. Tuning is by means of decade switches with continuous vernier coverage between the smallest switched steps. Several Models provide a simultaneous Square Wave output with adjustable amplitude, while others additionally provide a synchronous Pulse output which is controlled in width and polarity as well as in amplitude. The Oscillator consists of a highly regulated power supply, a frequency-determining R-C network, two high-gain differential amplifier stages, square wave and pulse stages if required, and a unique AVC circuit that provides a high degree of cycle-to-cycle amplitude control.

## 1.3 TECHNICAL SUMMARY

The following specifications are stated without reference to specific Model numbers except where such reference is essential. Any specifications relating to square wave or pulse performance will be understood as applying only to those instruments that include these functions. Specifications stated as applying to a basic Model number also apply to the square wave and pulse options of that Model.

Frequency range:

Model 4000: 0.1 Hz to 100 kHz, continuously variable in three decade bands:

| Band | Multiplier | Frequency (Hz) | Vernier Range (Hz) |
|---|---|---|---|
| 1 | 1 | 0.1-1,000 | 1 |
| 2 | 10 | 1,000-10,000 | 10 |
| 3 | 100 | 10,000-100,000 | 100 |

Frequency control: Three rotary FREQUENCY switches, decade MULTIPLIER switch, and VERNIER overlapping the interval between adjacent positions of the third FREQUENCY switch. The VERNIER is also used to cover the lowest frequency decade, when all FREQUENCY switches are set at zero and the MULTIPLIER switch is in its lowest (Band 1) position.

Frequency calibration accuracy:

Model 4000: ±0.5% from 10 Hz to 10 kHz, rising to ±1% at 50 kHz, ±2% at 100 kHz and to ±5% at 1 Hz.

Frequency stability:

vs. Time: Within ±0.02% from 10 Hz to 50 kHz, and ±0.1% from 0.1 Hz to 100 kHz, in any period of one hour or less. Within ±0.1% from 10 Hz to 50 kHz, and ±0.5% from 0.1 Hz to 100 kHz, in any period of ten hours or less.

vs. Line: Within ±0.005% for a 10% change in line voltage.

vs. Load: Within ±0.005% from 1 Hz to 10 kHz, and ±0.05% from 0.1 Hz to 100 kHz, no load to full load.

vs. Temperature: Within ±0.02% per degree C from 10 Hz to 50 kHz, and ±0.1% per degree C from 0.1 Hz to 100 kHz.

External synchronization: A 0.25 volt peak-to-peak signal will lock Oscillator over a range of approximately ±0.5% and distortion will increase to approximately 0.05%. Locking range and distortion increase linearly with input amplitude. Relative phase shift is controlled by Oscillator tuning. See section 2.3.5 for additional information.

Main and quadrature sine wave outputs:

Voltage: 10 volts rms maximum open-circuit, 5 volts rms across a matched load.

Current: 30 milliamperes maximum.

Power: 125 milliwatts maximum from each output simultaneously into 200-ohm loads.

Harmonic distortion:

Model 4000: Main Output: Less than 0.01% from 10Hz to 20 kHz, rising to 0.05% at 50 kHz, and 0.1% at 0.1 Hz and 100 kHz. Quadrature output is approximately twice these values.

Frequency response (no load or resistive load):

Model 4000: Main output: ±0.01 db from 20 Hz to 20 kHz, ±0.05 db from 1 Hz to 100 kHz, ±0.5 db at 0.1 Hz. Quadrature output: ±0.1 db from 20 Hz to 20 kHz, ±0.5 db from 0.1 Hz to 100 kHz.

Amplitude stability:

vs. Time: Within ±0.1% from 20 Hz to 20 kHz, and ±0.05% from Hz to 100 kHz, in any period of one hour or less. Within ±0.02% from 20 Hz to 20 kHz, and ±1% from 1 Hz to 100 kHz, in any period of ten hours or less. Within ±0.1% from 20 Hz to 20 kHz, and ±5% from 1 Hz to 100 kHz, in any period of 100 hours or less. Quadrature amplitude is less stable by a factor of approximately 2.

vs. Line:

Model 4000: Within ±0.001% from 20 Hz to 20 kHz, and ±0.01% from 1 Hz to 100 kHz, for a 10% change in line voltage within operating limits. Quadrature amplitude change is approximately twice these values.

vs. Temperature:

Model 4000: Within ±0.01% per degree C from 20 Hz to 20 kHz, and ±0.1% per degree C from 1 Hz to 100 kHz. Quadrature amplitude change is approximately twice these values.

Tuning transients: Typical deviation 0.2 db, recovering to original amplitude within a few cycles. Maximum deviation under worst conditions is approximately 1 db, depending on actual switching point in the cycle.

Hum and noise: Less than 0.01% of output at any setting of output attenuators. Cycle-to-cycle amplitude variation less than 0.01%.

Amplitude modulation (line frequency beat): Less than 0.01% near line frequency or its harmonics.

Output circuit: Direct-coupled resistive network.

Dc component: Nominal zero volts. At maximum output, drift is less than 1 millivolt per degree C, less than 1 millivolt for a 10% line voltage change, and within ±5 millivolts in any period of 10 hours or less. Drift reduced in proportion to output signal.

Floating (ungrounded) operation: A grounding switch is provided to disconnect the signal ground from the chassis ground. In this mode, performance is slightly reduced above 10 kHz. Balanced output operation is possible in the "floating: mode.

Main sine wave output:

Amplitude control:

Models 4000, 4010: Eleven position switch providing ten 1-volt increments from zero to 9 inclusive. In an additional position (0-0.1) a concentric infinite-resolution vernier provides continuous control from near zero (approximately 1 millivolt) to a nominal 100 millivolts. In the next ten positions this vernier covers a nominal 1-volt range.

Amplitude calibration accuracy:

Models 4000, 4010: At no load with vernier amplitude control at maximum ccw position, within $\pm$2% of indicated attenuator setting $\pm$2 millivolts for frequencies from 1 Hz to 20 kHz, rising to $\pm$2% $\pm$20 millivolts at 100 kHz.

Internal impedance:

Models 4000, 4010: Constant 200 ohms and 600 ohms, $\pm$2%.

Quadrature sine wave output:

Amplitude control:

Model 4000: Output fixed at 10 volts rms, $\pm$2%.

Ambient temperature and duty cycle: Continuous operation from zero to 50 degrees C.

Power requirements: 105-130 or 210-260 volts, single phase, 50-400 Hz, 30 watts.

Dimensions and Weights:

Bench Models 4000, 4002, 4004: 8 5/8" wide, 3 1/2" high, 17"
12 lbs. net, 21 lbs. shipping

All Rack Models: 19" wide, 3 1/2" high, 16" deep,
20 lbs. net, 26 lbs. shipping.

Specifications are subject to change without notice.

SECTION 2

OPERATING INSTRUCTIONS

## 2.1 CONTROLS AND CONNECTORS

All operating and external adjustment controls, and all signed connectors, are listed in Table 2. Nomenclature is as it appears on the instrument itself.

TABLE 2 - Controls and Connectors

| Controls | Applicable Models | Description and Function |
|---|---|---|
| FREQUENCY Hz | All | Three rotary decade switches, each with ten positions (0-9) to establish significant figures of the operating frequency. |
| MULTIPLIER/ | All | Concentric decade multiplier switch and vernier. Multiplier selects frequency band (see FREQUENCY RANGE, paragraph 1.3). Vernier provides continuous tuning over the interval between adjacent positions of the third FREQUENCY Hz switch, and is also used to cover the lowest frequency decade when all FREQUENCY Hz switches are set at zero and the MULTIPLIER switch is in its lowest (Band 1) position. |
| RMS VOLTS | 4000 | Control for Main sine wave amplitude. Eleven position switch providing successive 1-volt ranges from 0 to 10, plus a separate range from 0 to 100 mv, with a concentric vernier for continuous coverage of each range. |
| FLOATING/ CHASSIS | All | Slide switch (rear of chassis) operating on all outputs simultaneously, to permit choice of either isolated (floating) or chassis-ground connection. |
| POWER-ON | All | Toggle switch with indicator light. |
| Adjustments | | |
| MAIN OUTPUT DC LEVEL ADJUST | All | Screw-driver adjustment (rear of chassis) for setting dc level of Main sine wave output. |
| QUAD OUTPUT DC LEVEL ADJUST | All | Screw-driver adjustment (rear of chassis) for setting dc level of Quadrature output. |

All connectors are coaxial, Type BNC. Main sine wave and Quadrature (cosine) outputs are provided at 600-ohm and 200-ohm impedance levels. Square Wave and Pulse outputs, in Models where these are available, are at a 50-ohm impedance level. The EXTERNAL SYNC Type BNC connector on the rear of the chassis in all Models is the input for an external synchronizing signal. Also on the rear of the chassis is a multi-purpose binding post providing a separate chassis tie point independent of the signal ground connection of the input or output cables.

## 2.2 OPERATING PROCEDURE

To turn on the Oscillator, plug the power line cord into an ac outlet providing 105-125 volts (or 210-250 volts if the instrument is so wired), single phase, 50-400 Hz power. Turn the POWER switch to the ON position, noting that the indicator lamp lights. Allow the Oscillator to warm up for at least 15 minutes, and preferably for one-half hour if maximum stability of frequency and output amplitude are desired.

### 2.2.1 Selecting A Frequency

To select a frequency, proceed as follows:

a. Determine the band which contains the desired frequency, and set the FREQUENCY Hz - MULTIPLIER switch for that band.

b. Turn the three FREQUENCY Hz decade switches to the first three significant figures of the desired frequency.

NOTE: For maximum frequency accuracy, the first decade switch should not be set to zero. Thus, the frequency 15 Hz could be selected by placing the MULTIPLIER switch in the x1 position, turning the first decade switch to 0, the second to 1, and the third to 5. It is preferable, however, to select this frequency by placing the MULTIPLIER switch in the x0.1 position, and turning the first decade switch to 1, the second to 5, and the third to 0.

c. Check the position of the VERNIER knob. With full counterclockwise rotation, the frequency is as set by the three decade switches, and it is this position (as indicated by an arrow and the letters CAL) which is assumed in the frequency accuracy calibration specifications. As the vernier is rotated clockwise, the operating frequency increases continuously from the value corresponding to the set position of the third decade switch, to a value corresponding to the next higher position of that switch.

The VERNIER is also used to cover the lowest frequency decade when all FREQUENCY switches are set at zero and the MULTIPLIER switch is in its lowest (Band 1) position. Although this control is not calibrated, the frequency can be set quite accurately by the following procedure: Set all three FREQUENCY switches to zero and the MULTIPLIER switch to x100. The VERNIER now covers a range from 10 Hz to 100 Hz. Setting the VERNIER now to any frequency in this range and switching the MULTIPLIER back

to x1 will produce 1/100 of that frequency, and switching the MULTIPLIER to x.01 (Models 4010 and 4020) results in a frequency division of 10,000. For example, setting 60 Hz on x100 will give 0.6 Hz in the x1 position and 0.006 Hz in the x.01 position. When the VERNIER is used to cover the lowest frequency decade, optimum performance of the Oscillator is obtained when the dc level of the Main and Quadrature sine wave output is adjusted to zero as closely as possible. This can be obtained by setting the VERNIER to a frequency of approximately 50 Hz and adjusting the two screwdriver controls in the rear of the chassis to zero using a VTVM with a minimum full scale sensitivity of approximately 1 volt. Before doing this it is advisable to check and adjust, if necessary, the output dc level of the AVC amplifier as described in Calibration and Adjustment, Section 5.4.

### 2.2.2 Adjusting Sine Wave Output Amplitude

To adjust the amplitude of the Main sine wave output, proceed as follows:

In all except Models 4020, 4022, and 4024, turn the 11-position RMS VOLTS switch so that its indicator lies in the desired voltage range, then adjust for the required value by using the concentric vernier.

To adjust the amplitude of the Quadrature (cosine) output, proceed as follows:

a. In all except Models 4000, 4002 and 4004, turn the 11-position QUADRATURE RMS VOLTS switch so that its indicator lies in the desired voltage range, then adjust for the required value by using the concentric vernier.

b. In Models 4000, 4002 and 4004, the Quadrature output is fixed at 10 volts rms.

### 2.2.3 External Synchronization

All Models carry an EXTERNAL SYNC connector on the rear of the chassis. To synchronize the output of the Oscillator with an external signal, connect the external signal to the EXTERNAL SYNC input and tune the Oscillator to an internal operating frequency approximately at the mid-point of the range of variation expected of the external signal. With an external sine or square wave input of 1/4 volt peak-to-peak, the Oscillator output will be locked in frequency to the sync signal over a range of approximately ±1/2% of the Oscillator frequency setting, and distortion will be approximately 0.05%. Locking range and distortion increase linearly with input amplitude up to a maximum range of approximately ± 15%. With a sine wave input, the distortion is nearly constant within the locking range. However, with a square wave input, the distortion remains low in the center of the range, but is higher at the ends of the range than with a sine wave. With a sine wave clipped by back-to-back diodes, the distortion is lower over most of the range than with a sine or square wave for the same locking range.

### 2.2.4 Floating Or Chassis-Ground

On the rear of the chassis, a slide switched marked ALL OUTPUTS-FLOATING/CHASSIS permits operation with either isolated (floating) or chassis-ground connection. All outputs are simultaneously controlled by the position of this switch. If the Oscillator is isolated from its chassis ground its signal ground must be tied to a suitable external (remote) chassis ground point.

## 2.3 POWER LINE CONNECTION

As originally shipped, the Oscillator is connected for operation from 105-125 volts ac, except when specifically ordered otherwise. To change the connections for operation at 210-250 volts, remove the jumpers between terminals 1 and 3 and terminals 2 and 4 of the power transformer, and jumper terminals 2 and 3.

# SECTION 3

# CIRCUIT DESCRIPTION

## 3.1 INTRODUCTION

A regenerative circuit will oscillate if two conditions are fulfilled. The net phase shift around the entire regenerative loop must be zero degrees and the voltage gain around the loop must be exactly unity at the oscillating frequency. In the 4000 Series Oscillator, two amplifiers, in conjunction with their associated networks $R_1C_1$ and $R_2R_3C_2$, produce a net phase shift of zero degrees at the oscillating frequency. Refer to Figure 2 Simplified Block Diagram. The phase shift introduced by $R_1C_1$ is 45 degrees leading,

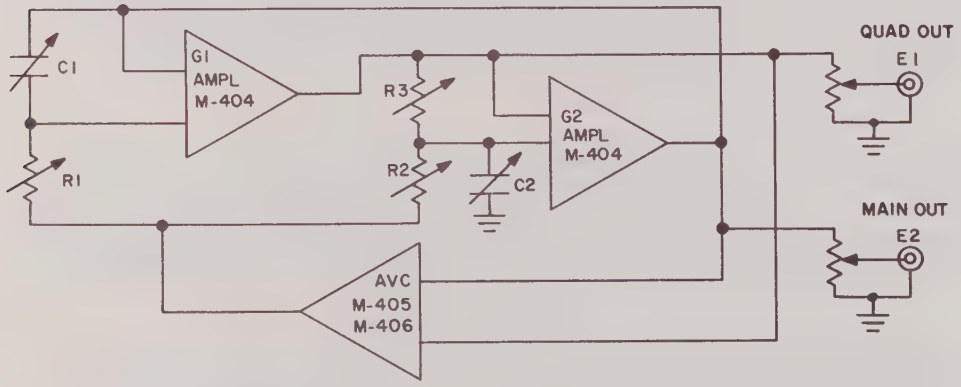



Figure 2. Oscillator Simplified Block Diagram

and that produced by $R_2R_3C_2$ is 45 degrees lagging, for a net shift of zero degrees around the entire loop. The phase relationship established in this manner leads to two useable output signals $E_1$ and $E_2$ which bear a fixed 90 degree relationship to each other at any oscillating frequency.

A net loop gain of unity is obtained by the AVC[ automatic volume (gain) control] circuit which samples the output voltage $E_2$, comparing it to a stable dc reference voltage and generates a control signal. This control signal maintains the overall loop gain at exactly unity by reducing or increasing the gain when the output voltage, $E_2$, changes for any reason. Since the output voltage $E_2$ is the one which is sampled and controlled, it is called the Main sine wave output, where $E_1$ is called the Quadrature (cosine) sine wave output.

### 3.2 FREQUENCY DETERMINING CIRCUITS

The tuning controls for this Oscillator consist first of a decade band switch which selects a pair of capacitors, $C_1$ and $C_2$, of the same value to establish each decade or band of frequency. Resistors $R_1$, $R_2$ and $R_3$ establish the frequency within decades, and a vernier adjustment in the form of a dual potentiometer shunting both resistor networks is provided for setting frequency between the smallest digit increments, thus giving continuous frequency coverage. The vernier is also the sole frequency control for the lowest decade of the frequency range.

### 3.3 AMPLIFIERS

Both amplifiers are identical using Amplifier Module M404 shown in Figure 11. The Amplifier consists of three gain stages and an emitter follower output stage. The differential input stage uses two field effect transistors, Q403A and Q403B, plus three transistors Q401, Q402 and Q409. Input 1, a very high impedance input, is connected to the gate of Q403B, and input 2, a low impedance input, is connected to the gate of Q403A after being added to the output signal in feedback summing resistors R403 and R404. Q409 acts like a high-value load resistor while at the same time passing the required bias current with a relatively low supply voltage. A high effective load resistance at this point approximates a constant-current source and maintains the sum of the input stage drain currents constant. The common-mode signal, appearing at the junction of R412 and R413 at practically full amplitude, is added to a positive dc level and then fed to the input stage drain load resistors through the unity-gain amplifier loop, Q401 and Q402. R412 and R413 are trimmed to set the output dc level to its nominal value, zero volts. The differential output signal of the first stage, developed across R415 and R416, is connected to the bases of Q404 and Q405, the second differential gain stage. Q410 functions in exactly the same manner as Q409 and provides high-common-mode signal rejection in the second stage. A single-ended output signal is taken from R410 and fed to the base of Q406. This is a grounded-emitter stage which is used to drive the output follower. The complementary push-pull emitter follower output stage, Q407 and Q408 is fed directly from the collector of Q406. CR401 and CR402 provide thermal compensation and also establish a bias for proper quiescent current in Q407 and Q408.

### 3.4 AVC

The AVC circuit consists of two modules, the Main AVC module M405, as shown in Figure 12 and the Reference AVC module M406, shown in Figure 13. The AVC output is a square wave whose amplitude is dependent on the deviation of the Main sine wave output, $E_2$, from its correct amplitude, and whose phase with respect to the Quadrature sine wave output, $E_1$, is zero or 180 degrees, depending on the direction of $E_2$ deviation. The AVC can best be understood by utilizing the Simplified Block Diagram shown below in Figure 3 in conjunction with the schematics Figure 12 and 13.

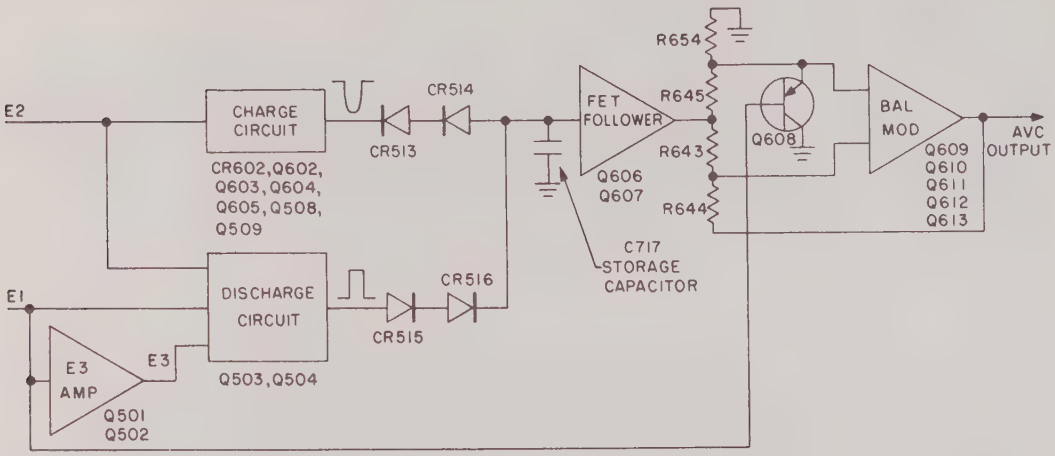



Figure 3. AVC Simplified Block Diagram

The basic principle of operation of the AVC circuit is that of depositing a charge on a storage capacitor C717 proportional to the Main sine wave amplitude, $E_2$, and using the resulting dc potential to control the balanced modulator which provides the AVC output signal. The potential across C717 is determined by the relative amplitude of both the Charge pulse and Discharge pulse. The Charge pulse, appearing at the collector of Q509, is negative and its width and amplitude vary with $E_2$ amplitude. This is accomplished by back biasing diode CR602 and permitting only the extreme negative peak of $E_2$ to be amplified by Q602. The Discharge pulse, appearing at the collector of Q504, is positive and of constant amplitude and width. It is generated by rectifying $E_1$, $E_2$ and $E_3$ via diodes CR502, 503 and 504. The composite rectified signal drives Q504 to conduction at the negative peak of $E_2$. If the $E_2$ level is correct, the net potential of capacitor C717 after both pulses have occurred is zero. If the amplitude of $E_2$ increases, the amplitude of the Charge pulse increases and a net negative potential is left on C717, since the amplitude of the Discharge pulse remains constant. Conversely, if the amplitude of $E_2$ decreases, the potential of C717 becomes positive.

The dc potential of C717 is transferred to the balanced modulator by FET follower Q606 and emitter follower Q607. The modulator Q608 is supplied with the dc error signal from Q607, and Quadrature output signal, $E_1$. The action of Q608 is such that when the dc error signal is zero, no ac signal whatever is generated at the base of Q609. If the dc level goes positive, Q608 conducts when $E_1$ goes negative and the dc level at the base of Q609 is pulled back down to ground level during the time $E_1$ is negative. The phasing is such that the resulting AVC correction signal is a square wave in phase with the $E_1$ signal. When the dc level goes negative, conduction in Q608 again takes place when $E_1$ is negative, but in this case the base of Q609 is pulled up to ground level during the time $E_1$ is negative. The AVC correction signal again is a square wave, but in this case the phasing is such that the square wave is 180 degrees out of phase with $E_1$.

### 3.5 TRANSIENT CONDITIONS

The preceding discussion covers the steady-state condition when the output amplitude is normal or very close to normal. When the output amplitude deviates widely from normal, fast recovery circuits restore normal amplitude more rapidly. When the level of $E_2$ drops below normal, Q605 becomes non-conducting, and the Discharge pulse path to C717 is paralleled by the low impedance path consisting of R537, C510 and CR519.

When the $E_2$ amplitude is above normal, the Charge pulse path is paralleled by the low impedance path consisting of R534, C511 and CR521. The Charge pulse is normally narrower than the Discharge pulse and CR509 clamps any Charge signal at the junction of R534 and C511. However, when $E_2$ exceeds its normal level, the Charge pulse becomes wider and two large charge pulses are fed to C717 through C511, lowering the potential of C717 and restoring the correct $E_2$ amplitude. When the amplitude of $E_2$ is extremely high, a direct path is provided by diodes CR521 and 522 for the negative half-cycle of $E_2$ to discharge C717 very rapidly.

### 3.6 AMPLITUDE CONTROLS

Two types of amplitude controls are provided in the 4000 Series Oscillators. For the Main sine wave output $E_2$ a single decade switch and concentric vernier, as shown in the Main Assembly Schematic Diagram Figure 14, is used for amplitude control in the 4000 and 4010 series. In the 4020 series, also shown in the Main Assembly Schematic Diagram Figure 14, four switched decade attenuators are provided. The quadrature output amplitude control in both the 4010 and 4020 series consists of a single decade control and concentric vernier. In the 4000 series there is no Quadrature amplitude control.

### 3.7 POWER SUPPLY

The Power Supply Module, M401, as shown in Figure 10 furnishes three regulated voltages of +25, +20, and -20 volts. The plus 25 volt output is obtained from the first regulating circuit. Z101 supplies the reference voltage, Q101 and Q103 are the regulating amplifiers, and Q701 is the series transistor. Using plus 25 volts as a reference, the minus 20 volt output is obtained from the second regulating circuit. Q107, Q108 and Q110 are amplification stages, and Q702 is the series transistor. Current limiting is provided within the amplifier by voltage developed across R125 and amplified by Q109. The plus 20 volt supply uses the minus 20 volt regulated output as a voltage reference. Q104 is the regulating amplifier and Q105 is the series transistor. Current limiting for the plus 25 volt output is provided by voltage developed across R101 and amplified by Q102. In a similar manner, current limiting for the plus 20 volt output is provided by voltage developed across R119, amplified by Q106, and fed in to the plus 25 volt regulating amplifier via Q102.

### 3.8 SQUARE WAVE AND PULSE GENERATOR

The optional Square Wave and Pulse generator module M402 is triggered by the sine wave output. As shown in the Schematic Diagram Figure 15, the sine wave is first shaped by the input Schmidt trigger circuit consisting of Q207, Q208 and Q209 to produce a square wave suitable for triggering the multivibrator, Q203 and Q204. Q210 and P201 adjust the triggering level of the input Schmidt trigger and thus control the symmetry of the square wave trigger pulses. The multivibrator output, which is in phase with the input trigger signal, is fed to switch circuit Q201 and Q202, and the other output is fed to switch Q205 and Q206. Q214 is a constant-current source which supplies 50 milliamperes to the output P-P Volts potentiometer, developing a level of plus 2.5 volts dc at the output under conditions of no signal, no load, and maximum setting of the output control. Q215 is normally non-conducting. When the Function switch is in the square wave position, Q215 passes 100 milliamperes and sets the output dc level at minus 2.5 volts for no signal, no load, and maximum setting conditions. Switch circuit Q205 and Q206 selects the negative-going multivibrator output which turns Q215 off and produces a square wave at the output which is in phase with the sine wave output. The pulse width Schmidt trigger is disabled and does not operate in the square wave position. In the pulse positions of the Function switch, when the multivibrator is triggered by the positive-going sine wave crossing of the zero axis, current flows into the pulse width capacitors, allowing the potential at the input of the pulse width Schmidt trigger Q211, Q212 and Q213 to rise at a rate determined by the capacitor value and the setting of the Pulse-Width control. When this potential reaches the triggering level of the width trigger, a signal is sent to the multivibrator to reverse its state, thus forming a pulse rather than a square wave. When the Function switch is in the plus pulse position, the operation is the same as for a square wave output except that the duration of the positive excursion is reduced. In the minus pulse position, switch Q201 and Q202 selects the positive-going pulse from the multi-vibrator to turn Q215 on for the duration of the pulse, thus forming a negative-going output pulse.

### 3.9 SQUARE WAVE

The Square Wave Module, M403, as shown in the Schematic Diagram Figure 16, is similar to module M402 but provides only a Square Wave output. The pulse width Schmidt trigger, the Function and Pulse-Width controls, and the switch circuits are not included. Only the internal symmetry control and the external P-P Volts control remain. The input Schmidt trigger, multivibrator and output circuits function as described above.

## SECTION 4

## MAINTENANCE

### 4.1 INTRODUCTION

If the Oscillator is not functioning properly and requires service, the following procedure may facilitate locating the source of trouble. The general layout of major components of the Oscillator is shown in Figure 4. The Oscillator consists basically of a main chassis and five or six plug-in modules. These modules include a Power Supply Module M401, a Square Wave and Pulse Module M402 or Square Wave Module M403 (both optional), two Amplifier Modules M404, a Main AVC Module M405, and a Reference AVC Module M406. Component layouts and parts lists for these Modules are included with their schematics at the end of this manual.

Access to the Oscillator is accomplished easily without any hand tools by removing the top and bottom covers. It is first necessary to loosen (not remove) the two thumb screws centered on each side at the rear of the chassis and then pulling out the two side covers. This unlocks the top and bottom covers which then may be pulled out.

The most frequently used check points have been provided with test jacks. These jacks are color coded and are identified as shown in Figure 4. When servicing the various plug-in modules, a plug-in extension card fastened internally to the side of the chassis is provided to allow access to the components of the module while the unit is in operation.

Many troubles may easily be found by visual inspection. When a malfunction is detected, make a quick check of the unit for such things as broken wires, burnt or loose components, or similar conditions which could cause trouble. When a malfunction is encountered, before beginning troubleshooting it should be determined if the normal adjustments mentioned in Calibration and Adjustment procedure, Section 5, will correct the trouble. Any troubleshooting of the Oscillator will be greatly simplified if there is an understanding of the operation of the circuit. Before any detailed troubleshooting is attempted, reference should be made to Circuit Description, Section 3. When a problem is encountered, it should first be determined if the malfunction is present under all conditions, or is only present under certain conditions such as certain frequency selector switch positions or on certain frequency multiplier bands. If the problem seems to be of a general nature, the troubleshooting procedure outlined here should be followed. If the trouble is only present under specific conditions, however, the procedure must be adapted to fit the circumstances. Because of the floating ground provision, measurements to chassis should not be done until the Floating/Chassis grounding switch, located at the rear of the chassis, is in the Chassis position.

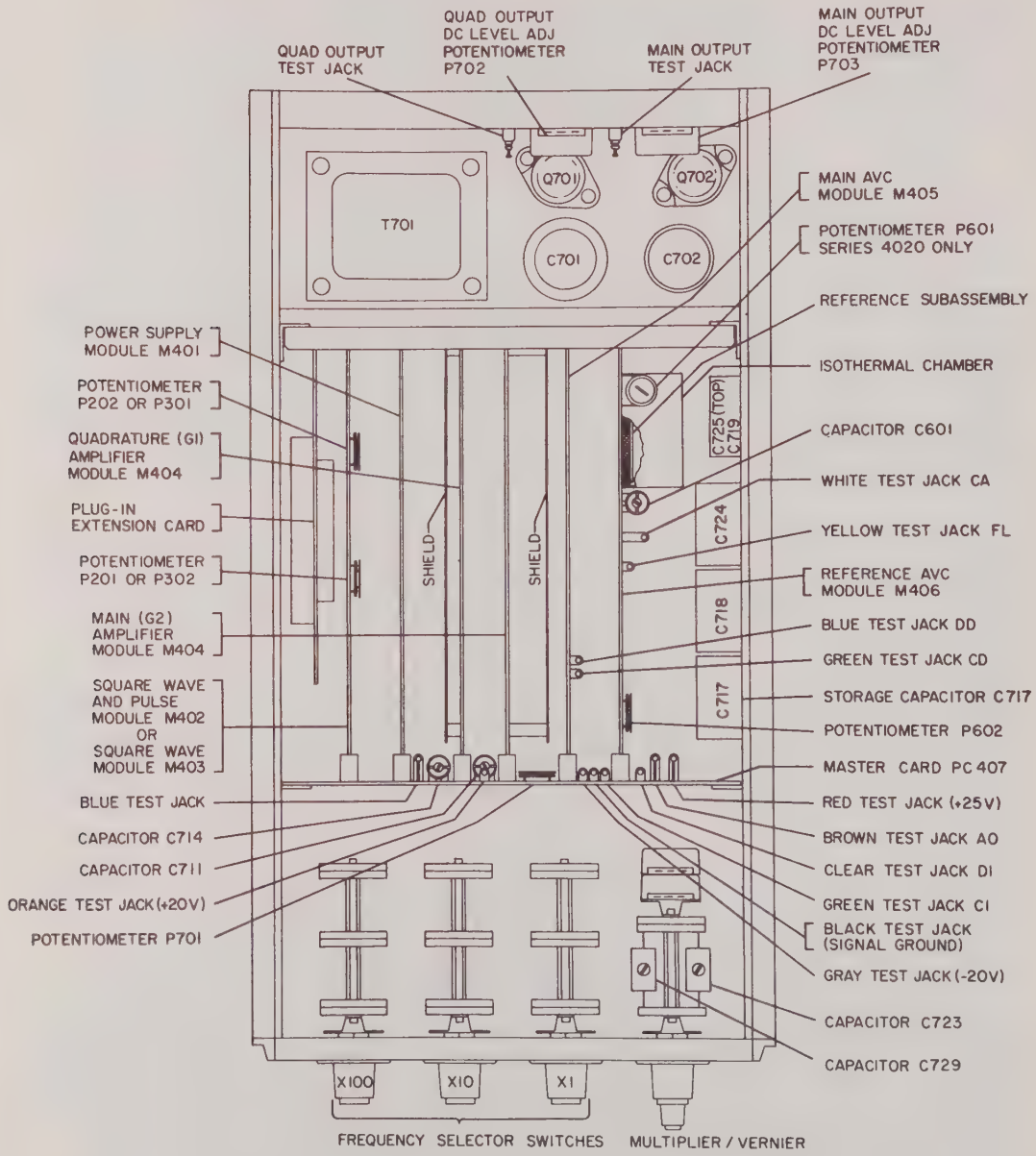



Figure 4. Top View of Main Assembly Chassis

## 4.2 PRELIMINARY CHECKS

The Oscillator should be set up as follows:

1. Frequency selector switches at 100
2. Frequency Multiplier switch at 10
3. Main output amplitude controls at maximum cw
4. Quadrature output amplitude controls at maximum cw (if applicable)
5. Floating/Chassis grounding switch in chassis position

If the sine wave outputs appear to be correct, but the Pulse and/or Square Wave (where applicable) is not, refer to Section 4.9. First check the three dc Power Supply voltages, +25 vdc (red test jack), +20 vdc (orange test jack), -20 vdc (grey test jack). If these levels are off by more than ±5%, refer to Section 4.4. If these supplies are correct, the Main and Quadrature output dc levels should be checked. To eliminate any ac signals when making these measurements connect a 0.02 uf capacitor in series with a 1200 ohm resistor from the blue test jack on the Master card (caution: there is also a blue test jack DD on the main AVC Module, M405) to chassis ground. Also remove the Reference AVC Module, M406, and ground the brown test jack (AO). These dc levels should both be within less than ±0.1 volt. Screwdriver controls and associated test jacks are provided at the rear of the chassis for monitoring and adjusting these levels. If the correct levels can not be obtained, the trouble is probably in either the G1 or G2 Amplifier Modules, M404. If the levels are both off in the same direction (either plus or minus), the trouble is probably in the G1 Amplifier Module. If the dc levels are off in different directions (one plus and one minus), the trouble is probably in the G2 Amplifier Module. When the trouble has been isolated to a particular module, reference should be made to section 4.5. If the Main and Quadrature output dc levels are correct, a signal tracing analysis should be used to find the source of trouble.

## 4.3 SIGNAL TRACING

Connect an external signal source as shown below in Figure 5. This source should be capable of providing a 10 volt rms sine wave into a 1000 ohm load

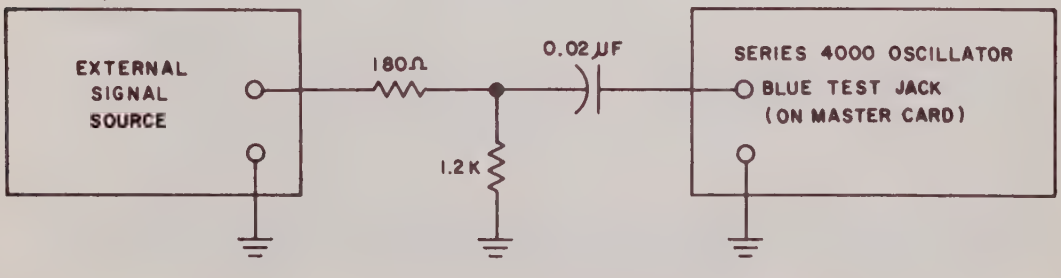



Figure 5. Circuit for External Signal Application

at 1000 Hz. The Reference AVC Module, M406 should remain out of the unit and the brown test jack (AO) should remain grounded for this check. Adjust the external source to provide 8.1 volts rms, and check the Quadrature output voltage. This should be a sine wave with an amplitude of approximately 10 volts rms. If this signal is incorrect, the trouble is probably in the G1 Amplifier Module. If the Quadrature signal is correct, check the Main Output voltage. This should also be a sine wave of approximately 10 volts rms amplitude. If this signal is incorrect, the trouble is probably in the G2 Amplifier Module. When the trouble has been isolated to a particular module, reference should be made to Section 4.5.

The Main and Quadrature output should be approximately 90 degrees out of phase. If this phase relationship is not correct there may be a problem in the tuning network (see Section 4.7).

If both the Main and Quadrature output signals appear to be correct, the trouble is probably in the AVC section of the Oscillator. In this case, reference should be made to Section 4.6.

### 4.4 POWER SUPPLY

The Power Supply consists of three separate supplies of plus 25, plus 20, and minus 20 volts. The plus 25 is used as a reference supply for the minus 20, and the minus 20 is used as a reference supply for the plus 20. This fact should be kept in mind when doing any work on the supply, as a malfunction in the plus 25 will be reflected in the other two, and a malfunction in the minus 20 will be reflected in the plus 20. If the other supplies do not seem to be working properly, the plus 25 should be checked before beginning work on them; if the plus 20 is not working, the minus 20 should be checked first. The three supplies have current limiting circuits which will shut down the supply if excessive current is being drawn from it. For this reason an apparent malfunction in the supply could be caused by an overload in one of the other circuits.

Nominal voltages for various points in the supply are given on the schematic, Figure 10. If a malfunction occurs the error signal thus developed should be traced through the circuit to find the faulty component. Let us suppose for example that the plus 25 was lower than normal. This would produce an error signal which would make both the base and emitter of Q103 more negative than normal. Because the base moves less than the emitter the total result is a lowering of the collector of Q103 from its normal value. The base of Q101 should then be made more negative than normal and the collector more positive. This will raise the base of Q701 and finally should correct the output level. Had there been a bad component somewhere in the circuit, this correcting action would have been blocked. The faulty component would then have been found at the point in the circuit where the action was blocked. The same basic method of troubleshooting described above may also be used in the other supplies when a malfunction occurs.

If it becomes necessary to replace the reference zener Z101, the voltage of the plus 25 supply will probably have to be readjusted. This may be done by trimming R115. This supply should be trimmed until plus 25 is within ±5%.

## 4.5 AMPLIFIER MODULE

When a problem has been isolated to one of the Amplifier Modules, the other Amplifier Module should be removed from the unit so that there will be no interaction between the two during troubleshooting. If the G1 Module has been removed, the Quadrature output should then be tied to chassis ground. If the G2 Module has been removed, the Main output should be tied to chassis ground. In addition, the Reference AVC Module, M406 should be removed from the unit and the brown test jack (AO) should be tied to ground.

Under the above conditions, measure the dc output level of the Amplifier under test. This will be the Quadrature output for the G1 Amplifier Module and the Main output for the G2 Amplifier Module. If the level is greater than ±0.5 volt there is probably trouble in the Amplifier, and the dc error signal thus developed should be traced through the circuit. For example, if the output level is plus, the feedback should raise the gate of Q403A from its normal value of zero. Through the differential stage this will then cause the drain of Q403B to become more positive than the drain of Q403A. The collector of Q404 will then go more positive while the collector of Q406 will go more negative than their normal values. This should then lower the emitters of Q407 and Q408 and correct the output level. If a faulty component is present in the circuit, it will usually prevent this corrective action from taking place. The faulty component will be found at the point in the circuit where the correcting action is blocked.

Most problems in the Amplifier will show up in a level check and the troubleshooting method described above may be used to find the problem. If all the levels seem to be right and the unit seems to be working but will not take a load, Q407 and Q408 should be checked.

If it becomes necessary to replace the dual field effect transistor, Q403A and Q403B, the output dc level may have to be retrimmed for the new unit. With the same initial set up as given at the beginning of this section, check the dc level at the output of the Amplifier in question (Quadrature output for G1, Main output for G2). If this level is other than zero, and the level control will not correct it, R412 and R413 should be adjusted. One of these resistors should be zero ohms at all times. The other is then adjusted to provide zero output level. If the output is plus, an increase in R413 will correct it. If the level is negative, an increase in R412 will correct it. The adjustment should be made with the dc level control in the center of its range to give an optimum range of adjustment.

## 4.6 AVC CIRCUIT

If there appears to be trouble in the AVC circuit, remove the ground lead from the brown test jack (AO), insert the Reference AVC Module, M406 in the unit, and check various waveforms as follows:

The unit should remain set up for an external input signal as shown in Figure 5. The signal from the external source should be varied in amplitude so that the voltage of the Main output varies from 9 to 11 volts rms. It should be noted that the signal on the Main output will be somewhat

distorted when at the extremes of this range. While making this variation the signal at the brown test jack (AO) should be observed. When the Main output is at 9 volts rms, the AO signal should be a square wave in phase with the Quadrature output with an amplitude of at least 3 volts peak-to-peak. When the output is at 11 volts rms, the AO signal should be a square wave out of phase with the Quadrature output with an amplitude of at least 3 volts peak-to-peak. As the output is varied through 10 volts, the AO signal should go through a null. If this action takes place, the AVC circuit is probably functioning properly.

If the AO signal is not correct, check the Follower output level (FO) located at the emitter of Q607. This should be a dc voltage of at least plus 4 volts when the Main output is at 9 volts rms, and at least minus 4 volts when the Main output is at 11 volts rms. As the output swings through 10 volts rms, the FO voltage should swing through zero. If the FO signal is correct but AO is not, the trouble probably lies in the balanced modulator or the AO output loop.

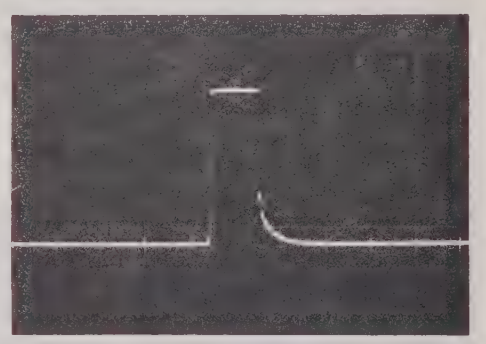
To determine if the modulator is operating properly, look at the signal on the base of Q609. When the Main output is made 9 volts rms the signal here should be a square wave in phase with the Quadrature output with an amplitude of at least 2 volts peak-to-peak. When the Main Output is made 11 volts rms the square wave should change phase and have an amplitude of at least 2 volts peak-to-peak. As the output is varied through 10 volts rms, the signal should go through a null. It should be noted that the dc level of this signal will normally change as its amplitude and phase changes. If the proper signal does not appear, check that a drive signal is reaching the base of Q608. If a drive signal is present but the modulator does not seem to be working, check Q608 and its associated components. If one of these components is changed, the symmetry of the AO signal should be checked. If necessary it may be adjusted by trimming R652. The flatness of the AO signal should also be checked. If necessary an adjustment may be made by trimming R645. If the proper modulator signal is present but the correct AO signal is not, the trouble is probably in the AO output loop.

If there appears to be trouble in the AO output loop, measure the dc level of the brown test jack (AO). This should be at zero volts ±0.5 volt. If this level is not right and the control will not correct it, the error voltage thus developed should be traced through the feedback loop. Nominal voltages for various points in the loop are shown on the Reference AVC Schematic, Figure 13.

As an example of this method of tracing, let us assume that AO is plus. Through the feedback this will make the base of Q610 more plus than normal. This should make the collector of Q610 more negative than normal, the collector of Q612 more negative than normal, and finally the output level should be corrected. When trouble is encountered, the faulty component will usually be found at the point in the loop where this corrective action is blocked. If, for example, in the previous case Q612 had been defective, its collector would not have gone more negative than normal when the base of Q611 went more negative than normal. This would then have been the point in the loop where the corrective action was blocked.

If the voltage at FO does not vary properly as the output is changed, check the voltage across the Storage Capacitor (SC), C730, located as shown in Figure 4. This is a high impedance point and care should be taken not to load it while making measurements. The measuring equipment should have an input impedance of at least 10 megohms. SC should vary from at least plus 4 volts through zero volts to at least minus 4 volts as the main output is varied from 9 to 11 volts rms. If SC varies properly but the FO does not, check Q606 and Q607 and their associated components.

If SC is not varying properly, check the waveform of the Discharge Drive pulse (DD) at the blue test jack located on the Main AVC Module, M405. This should be as pictured in Figure 6. If the DD pulse is not correct, check the three signals used by the DD circuit to develop the DD pulse. The three signals used are $E_1$, $E_2$, and $E_3$. $E_1$ is the Quadrature output before the attenuator, $E_2$ is the Main output before the attenuator, and $E_3$ a sine wave 180 degrees out of phase with the Quadrature output having an amplitude of approximately 7 volts rms. $E_3$ is developed from $E_1$ using an amplifier consisting of Q501, Q502, and their associated components. If these signals are being fed to the DD circuit but there is no DD pulse, the trouble is probably in Q503 or Q504 or their associated components.

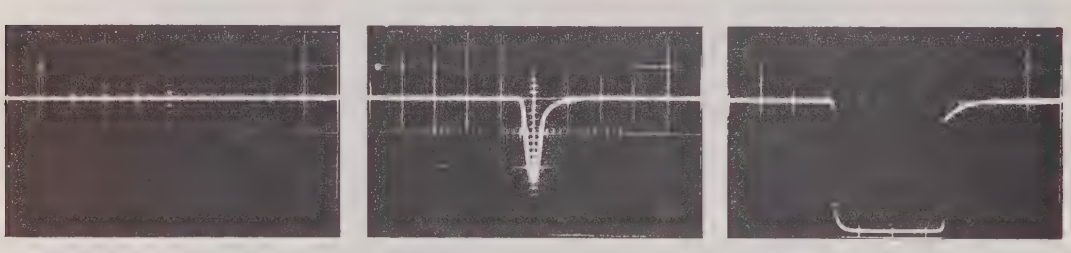


Vert-5v/cm Hor-50μs/cm

Figure 6. Discharge Drive Pulse

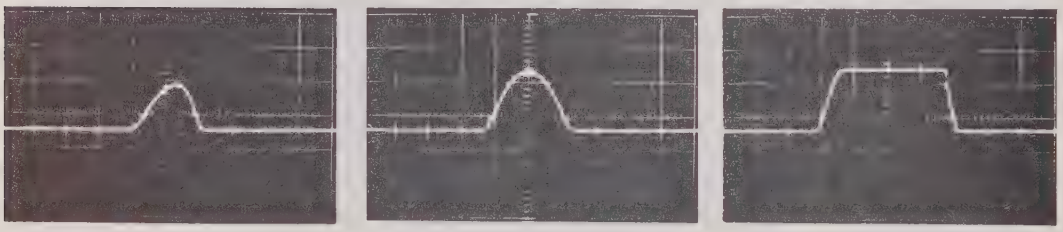
If any components are changed in the DD circuit or the $E_3$ amplifier, the position and width of the DD pulse should be checked. The DD pulse should then be approximately 18 degrees wide and should be centered about the Charge Drive pulse (CD) which is approximately 10 degrees wide when the Oscillator is functioning normally. R511 controls the start position of the DD pulse, R513 controls the stop position, and R514 controls the width.

If the DD pulse appears to be correct, check the waveform of the Charge Drive pulse (CD) at the green test jack located on the Main AVC Module, M405. While looking at this point, vary the Main output from 9 volts rms to 10 volts rms and then to 11 volts rms. The proper waveform of the CD pulse for these three conditions are shown in Figure 7. If these signals are not correct, check the waveform of the Charge Amplifier (CA) at the white test jack. The waveforms should be as shown in Figure 8 when the Main output is varied from 9 to 10 to 11 volts rms. If the CA is correct but CD is not, the trouble is probably in Q508, Q509, Q603 or Q604 or their associated components. If it becomes necessary to replace one of these components, R627 may have to be readjusted. To do this look at the FL signal at the yellow test jack. This should be as shown in Figure 9. R627 should then be adjusted so that the width of the lower portion of the signal is approximately 1.5 times the width of the upper portion. This adjustment should be made with the Oscillator in its normal operating condition (without the external signal).



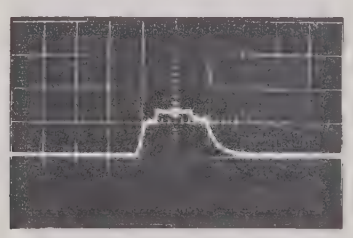
9 Volts 10 Volts 11 Volts

Figure 7. Charge Drive Pulse (CD) Shown when Main Output is at 9, 10 and 11 Volts rms. Vertical Sensitivity 5v/cm. Horizontal 50μs/cm.



9 Volts 10 Volts 11 Volts

Figure 8. Charge Amplifier Pulse (CA) Shown when Main Output is at 9, 10 and 11 Volts rms. Vertical Sensitivity 2v/cm. Horizontal Sensitivity 50 μs/cm.



Vert-0.5v/cm Hor-50μs/cm

Figure 9. FL Signal

If CA is not correct, check the various components associated with the reference subassembly, located on the Reference AVC Module, by removing the black plastic cover of the isothermal chamber. The problem may be in the reference zener Z601, diodes CR604, CR603, Q601, (used as collector base diode) CR602, and amplifier Q602 or their associated components.

### 4.7 TUNING NETWORK

Problems on certain multiplier bands or on certain positions of the frequency selector switches will usually be caused by something in the tuning network. If the trouble is on one particular multiplier band, the faulty component is probably one of the tuning capacitors associated with that band. If the trouble appears only at a particular setting of the frequency selector switches, the problem is most likely in the resistor(s) associated with that setting. The Main Assembly Schematic Diagram, Figure 14, shows which resistors come into play for each setting of the frequency selector switches. After determining which switch position is bad, reference to this figure should point out the faulty resistor.

### 4.8 OUTPUT ATTENUATORS (Main and Quadrature)

The Main Assembly Schematic Diagram, Figure 14, also shows the two types of attenuators used on the 4000 Series. If trouble is encountered with one of the attenuators, it should first be determined which position of the switch is bad. After determining this, reference to the appropriate attenuator should point out the faulty component.

### 4.9 SQUARE WAVE AND PULSE

The Square Wave and Pulse Module, M402 and Square Wave Module, M403 depend on the Main sine wave output for their operation. If the Square Wave or Pulse does not seem to be working, check to see if the Oscillator is operating properly before attempting to troubleshoot the Square Wave or Pulse. The 4000 Series also offers a Square Wave only option in addition to the Square Wave and Pulse option. They both use basically the same circuit for the square wave. This procedure will deal mainly with the Square Wave and Pulse whose Schematic Diagram is shown in Figure 15. Part numbers in parenthesis will apply only to the Square Wave circuit, shown in Figure 16, so the same procedure may be used for that portion of the circuit.

The Oscillator should be set up as follows before beginning troubleshooting of the square wave or pulse.

1. Oscillator frequency at 1000 Hz
2. Square Wave amplitude control at maximum cw
3. Function switch to square wave (if applicable)

If no Square Wave appears at the output, various waveforms should be checked as outlined below:

Reference should be made to Schematic Diagrams Figures 15 and 16. Check the waveform at point A. The signal here should be a square wave of approximately 9 volts peak-to-peak amplitude. If this signal is incorrect, the trouble is probably in Q207 (Q303) or Q208 (Q304) or their associated components. If point A appears to be correct, check the signal at point B. This also should be a square wave of approximately 9 volts peak-to-peak amplitude. If B is incorrect, the trouble is probably in Q209 (Q305) or Q210 (Q306) or their associated components.

With the correct signal at B, the waveform at C should be a square wave of approximately 4-5 volts peak-to-peak amplitude. Any discrepancy here would probably be caused by trouble in the multivibrator consisting of Q203 (Q301) and Q204 (Q302) and their associated components.

The waveform of point D should be a square wave of approximately 10 volts peak-to-peak amplitude when the correct signal is present at point C. If point D is not correct, the trouble is probably in the switching transistors Q201, Q202, Q205 or Q206 or their associated components. Since these switching transistors are omitted in the Square Wave Module, the output of the multivibrator (point C) is coupled directly to the output transistors. If the correct signal is present at point D but not at the output, check the output transistors Q214 (Q307) and Q215 (Q308) and their associated components.

The Pulse generator uses basically the same circuits as the Square Wave, therefore, before attempting to correct any problems with the Pulse, it should first be determined if the Square Wave is operating properly. If the Square Wave appears to be working, but the Pulse is not, the Oscillator should be set up as follows and various waveforms checked.

1. Oscillator frequency at 1000 Hz
2. Square Wave/Pulse amplitude control at maximum cw
3. Function switch to plus 10 - 100 $\mu$s
4. Pulse width control maximum cw

Check the waveforms at point F. It should be a sawtooth with a peak amplitude of 3 volts. If the proper signal is not present at point F, check C801, C802, C803, S801, R801, P801, R204 and CR201.

Check the waveform at point G. It should be a negative pulse of approximately 5-10 volts peak coinciding with the trailing edge of the sawtooth. If the signal at point G is not correct, check the Schmidt Trigger consisting of Q211, Q212, and Q213 and their associated components. If the proper signal is present at point G and the output pulse is still not correct, check C207, R211 and CR205 to determine if triggering signals are being fed to the multivibrator.

## SECTION 5

MAINTENANCE CALIBRATION AND ADJUSTMENT [1]

### 5.1 INTRODUCTION

The following procedure is provided for the purposes of cailitating the calibration and adjustments of the Series 4000 Oscillators in the field. The steps outlined should restore the Oscillator to its original specifications. It should be noted that some of the tolerances given in this procedure are much tighter than our general specifications. This is to ensure, in test, that all general specifications are met with adequate safety factor. These nominal tolerances, therefore, should not be used for purpose of accepting or rejecting the instrument. If any difficulties are encountered, please refer to Maintenance, Section 4. The location of all major components, modular sub-assemblies, test jacks, screwdriver controls and adjustments are shown in Figure 4.

Access to the Oscillator is accomplished easily without any hand tools by removing the top and bottom covers. It is first necessary to loosen (not remove) the two thumb screws centered on each side at the rear of the chassis and then pulling out the two side covers. This unlocks the top and bottom covers which then may be pulled out.

### 5.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform these tests:

a. Oscilloscope - having direct coupled horizontal and vertical amplifier with at least 10mv/cm sensitivity and a band width of 30 MHz, Tektronix type 545 or equivalent.

b. Differential Comparator Plug-In Unit, Tektronix Type W or equivalent.

c. Wide Band Plug-In Unit, Tektronix Type 1A1 or equivalent.

d. Precision Frequency and Period Counter - capable of measuring frequency from 100 Hz to 100 kHz and period from 1000 seconds to 1.0 millisecond.

e. Vacuum Tube Voltohmmeter - reading to 500 volts dc. Do not use this instrument for ac signal measurements.

f. Precision AC Differential Voltmeter, capable of measuring voltages from 10 mv to 10 volts rms from 30 Hz to 50 kHz with ±0.1% accuracy. Fluke Model 931P or equivalent.



[1] This procedure is to be used only in maintenance. For calibration procedure, see TB 750-236.

g. Variable auto-transformer - to adjust the line voltage from 105 to 125 volts.

h. Distortion Meter and/or Wave Analyzer - capable of measuring distortion below 0.01% from 20 Hz to 20 kHz, B&K Models 1607 and 2107 or equivalents.

i. AC Voltage Monitor - Krohn-Hite Model AC-601R or equivalent.

j. Phase meter capable of measuring phase angle to within 1 degree.

k. Strip Chart Recorder having 10 mv full scale sensitivity.

l. Thermal Transfer Voltmeter, Holt Model 6 or equivalent.

### 5.3 POWER SUPPLY OPERATION

With the Oscillator operating at 115 volts line, check the following dc voltages with respect to chassis. The Floating/Chassis grounding switch located on the rear of the chassis should be in the Chassis position. All test jacks are color coded and their locations are shown in Figure 4.

| Test Point | Voltage and Tolerance |
|---|---|
| Red test jack on Master Card | +25 vdc ±5% |
| Orange test jack on Master Card | +20 vdc ±5% |
| Gray test jack on Master Card | -20 vdc ±5% |

### 5.4 DC LEVEL ADJUSTMENTS

Adjust all dc level controls to zero ±10 mv, in the following order:

| | Test Point | Control |
|---|---|---|
| 1. | Brown test jack (AO) on Master Card | P602 located on Reference AVC Module, M406 |
| 2. | Main output test jack on rear of chassis | P703 located on rear of chassis |
| 3. | Quadrature output test jack on rear of chassis | P702 located on rear of chassis |

### 5.5 DISTORTION ADJUSTMENT

Set the Oscillator frequency to 10 Hz. Connect a high sensitivity oscilloscope (at least 10mv/cm) to the brown test jack (AO) on the Master card. Adjust P701 located on Master card for minimum signal. This signal

should be less than 10 mv peak-to-peak. Check other bands; the signal should be less than 10 mv at all frequencies up to 20 kHz. If it is not, readjust P701 for optimum setting.

Change the Oscillator frequency to 10 kHz and set the Multiplier switch to the x10 position. Adjust C714, located on the Master card for minimum signal. This signal should be less than 10 mv peak-to-peak.

Change the Oscillator frequency to 50 kHz. Adjust C711, located on the Master card, for minimum signal. This signal should be less than 30 mv peak-to-peak.

## 5.6 10 kHz FREQUENCY AND PHASE ADJUSTMENT

Set the Oscillator frequency to 10.0 kHz with the frequency vernier in the CAL position (maximum ccw). Check the frequency calibration using a frequency counter, at the same time monitoring the phase relationship between the Main output and the Quadrature output. If the frequency is off calibration by more than ±0.5% and the phase relationship is 90 degrees, adjust both trimmer capacitors C729 and C723, located on the Multiplier band switch as shown in Figure 4, in the same direction by approximately equal increments to correct the frequency without affecting the phase angle. If the frequency calibration is within 0.5% and the phase angle is out of tolerance, adjust C729 and C723 in opposite directions by equal increments. With a frequency counter and phase meter, check the frequency calibration and phase relationship of the Main output and the Quadrature output at other frequencies. If any frequency is out of tolerance, refer to Maintenance, Section 4.

## 5.7 DISTORTION

We recommend that the total harmonic distortion be checked at the following frequencies on both the Main and Quadrature outputs:

| | Tolerance | |
|---|---|---|
| Frequency | Main Output | Quadrature Output |
| 20 kHz | 0.01% | 0.03% |
| 10 kHz | 0.01% | 0.03% |
| 1 kHz | 0.01% | 0.03% |
| 100 Hz | 0.01% | 0.03% |
| 20 Hz | 0.01% | 0.03% |

Equipment that will measure distortion of this order of magnitude below 20 Hz is not known to be commercially available, therefore, this procedure does not cover the measurements beyond this range.

From 20 Hz up, this can be done fairly successfully by using a wave analyzer (GR, HP, B&K or Marconi) and a pre-filter (B&K and Marconi). Most manufacturers of wave analyzers have the same specification - 1% full scale on the most sensitive range with a 10 volt input signal and internal distortion of about 0.03%. If the pre-filter is set to attenuate the fundamental amplitude, say 60 db, to almost the level of the harmonics, then the analyzer sensitivity can be increased until the largest harmonic is full scale at the new sensitivity. Assume 0.01% second harmonic distortion only. The analyzer is calibrated for an input level (fundamental + harmonic) of 10 volts rms. When the analyzer is set to the second harmonic frequency, the meter sensitivity only can be increased to 1% full scale (0.1 volts) from 100% full scale or 10 volts. Since the residual analyzer distortion is 0.03%, the example value of 0.01% will not be measurable. Now, if we add a pre-filter and attenuate the fundamental, say 40 db, the analyzer input sensitivity can be increased 40 db for a full scale meter sensitivity of 0.01% and we can now read our theoretical second harmonic value of 0.01% with good accuracy.

Below 20 Hz, Krohn-Hite uses a noise meter type of instrument which has practically no residual distortion in the internal amplifiers - much less than the 0.03% specification of commercial analyzers and distortion meters, and which has an extremely sharp null. Because of the difficulty of achieving a very sharp null at low frequencies, the instrument is not continuously tunable but is fixed tuned at certain selected frequencies.

## 5.8 ATTENUATOR CALIBRATION

The Main output of the Series 4000 and 4010 and Quadrature output of the Series 4010 and 4020 use a single decade switch attenuator plus concentric vernier. Set the Oscillator frequency to 1 kHz. Using an ac voltmeter with better than 0.25% accuracy, check the calibration of the attenuator with the Vernier off (maximum ccw). The calibration accuracy should be within ±2% of indicated attenuator setting ± 2 millivolts.

Set the Oscillator frequency to 1 kHz. Check the calibration of the attenuator at other voltage settings. The accuracy should be within ±0.25% of indicated attenuator setting ± 1 millivolt.

## 5.9 FREQUENCY RESPONSE

Using a thermocouple voltmeter, such as the Holt Thermal Transfer Voltmeter, Model 6, compare the output voltage versus frequency from 20 Hz

to 20 kHz, it should be within ± 0.1%. The absolute voltage accuracy is not important because only changes in voltage are observed.

Below 20 Hz it is necessary to check the frequency response, using an ac-dc voltage comparator such as the Rotek Model 212H.

### 5.10 AMPLITUDE STABILITY

The long term amplitude stability may be monitored by using a suitable ac voltage monitor such as the Krohn-Hite Model AC-601R and a sensitive strip chart recorder. Connect the output of the Oscillator prior to the output attenuator to the input of the AC Monitor. Set the Oscillator frequency to 1 kHz. Set the input voltage controls on the AC Monitor to 10 volts. Connect the output of the AC Monitor to the input of a strip chart recorder. Adjust the input voltage controls on the AC Monitor for a null on the recorder at maximum sensitivity. When using the Krohn-Hite Model AC 601R in the maximum sensitivity (0.01%) position, a 0.01% change in input voltage will produce a 0.5 millivolt dc change in the output of the monitor. With a recorder having a full scale sensitivity of 10 millivolts, changes in ac voltages of 0.001% can be observed.

### 5.11 HUM AND NOISE (Cycle to Cycle Stability)

This specification can be checked by using a Tektronix scope with a type W differential comparator type plug-in unit or equivalent. Using 1 millivolt per centimeter sensitivity, check the cycle-to-cycle peak amplitude variations with the Oscillator output at 7 volt rms. The peak variations should be less than 1 cm (1 mv). The total hum and noise can also be observed on the peak of the waveform.

### 5.12 HUM MODULATION

Using the same method as above in step 5.11, check the line frequency modulation or beat at approximately 63 Hz and 123 Hz. The maximum peak excursion should be less than 1 cm (1 mv).

### 5.13 OUTPUT IMPEDANCE

Connect the 600 ohm output to an ac voltmeter. Adjust the output attenuator for a reading of 10 volts. Load the output with 600 ohms. The output voltage should drop to 5 volts. Repeat this check on the 200 ohm output using a 200 ohm load. This check can be performed at various attenuator settings. In each case the output voltage should drop 6 db when shunted with the matched load.

### 5.14 EXTERNAL SYNCHRONIZATION

Connect a 1 kHz signal of 1/4 volt rms amplitude to the SYNC input connector located on the rear of the chassis. Set the Oscillator to approximately 1 kHz. Connect the Main output of the Oscillator to the vertical amplifier of the scope and connect the external Oscillator to the horizontal amplifier of the scope. Set the scope up for display of a circular Lissajous pattern. The Oscillator should lock to the external signal over approximately a range of ±0.5%.

### 5.15 SQUARE WAVE ADJUSTMENTS (Where Applicable)

#### 5.15.1 Symmetry:

Using a wide-band oscilloscope (frequency range at least 30 mHz) connect the scope lead with a 50 ohm termination to the Square Wave output of the Oscillator. Set the Oscillator frequency to 100 kHz. Set the Oscillator Function switch to "square wave". Set the square wave amplitude control full CW. While observing the square wave symmetry, adjust Potentiometer P201, located on the Square Wave and Pulse Module, or P301, located on the Square Wave Module, for a 1% symmetrical waveform.

#### 5.15.2 DC Level:

Adjust Potentiometer P202, located on the Square Wave and Pulse Module or P302, located on the Square Wave Module, for zero dc level on the Square Wave output. This can be observed on the scope or by using a dc voltmeter connected to the square wave output terminal.

#### 5.15.3 Rise and Fall Time:

Using a 30 mHz bandwidth oscilloscope, with the sweep time calibrated for 20 nanoseconds per centimeter, measure the rise and fall time of the Square Wave at 100 kHz. The rise time is considered to be the horizontal displacement between the 10% and 90% points. The tolerance is less than 20 nanoseconds.

### 5.16 PULSE WIDTH (Where Applicable)

Using a calibrated sweep time on the oscilloscope, measure the Pulse width range in each position for both the negative and positive pulse. Each range should overlap so that there is continuous coverage from 0.1 microsecond to 100 microseconds.

SECTION 6

PARTS PROVISIONING LIST, SCHEMATICS, AND COMPONENT LOCATIONS

## 6.1 REPLACEMENT PARTS

6.2 To obtain replacement parts, find the manufacturer's part number and description in this manual and then refer to the appropriate Repair Parts and Special Tools List (RPSTL) TM. In the RPSTL, find the assembly or subassembly first and then the description which corresponds with that in this manual. Under the description in the RPSTL find the manufacturer's part number, and then order the part by the listed Federal Stock Number. If the part is not listed in the RPSTL, it should be requisitioned from the NICP in accordance with AR 725-50.

## RESISTORS

| Symbol | Description | | | Mfr. | Part No. | Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| R501 | 27K | 10% | 1/4W | AB | CB-2731 | R525 | 22K | 10% | 1/4W | AB | CB-2231 |
| R502 | 680 | 10% | 1/4W | AB | CB-6811 | R526 | 15K | 10% | 1/4W | AB | CB-1531 |
| R503 | 20K | 5% | 1/4W | AB | CB-2035 | R527 | 100 | 20% | 1/4W | AB | CB-1012 |
| R504 | 1.2K | 10% | 1W | AB | GB-1221 | R528 | 2.2K | 10% | 1/2W | AB | EB-2221 |
| R505 | 3.3K | 10% | 1/4W | AB | CB-3321 | R529 | 100 | 20% | 1/4W | AB | CB-1012 |
| R506 | 5.1K | 5% | 1/4W | AB | CB-5125 | R530 | 560 | 10% | 1/4W | AB | CB-5611 |
| R507 | 6.2K | 5% | 1/4W | AB | CB-6225 | R531 | 1K | 10% | 1W | AB | GB-1021 |
| R508 | 8.2K | 10% | 1/4W | AB | CB-8221 | R532 | 220 | 10% | 1/4W | AB | CB-2211 |
| R509 | 27K | 10% | 1/4W | AB | CB-2731 | R533 | 1K | 10% | 1/4W | AB | CB-1021 |
| R510 | 4.7K | 10% | 1/4W | AB | CB-4721 | R534 | 5.6K | 5% | 1/4W | AB | CB-5625 |
| R511 | 150K | 10% | 1/2W | AB | EB-1541 | R535 | 1.1K | 5% | 1/4W | AB | CB-1125 |
| R512 | 4.7K | 10% | 1/4W | AB | CB-4721 | R536 | 5.1K | 5% | 1/4W | AB | CB-5125 |
| R513 | 270K | 10% | 1/2W | AB | EB-2741 | R537 | 6.8K | 5% | 1/4W | AB | CB-6825 |
| R514 | 68K | 10% | 1/2W | AB | EB-6831 | R538 | 82K | 10% | 1/4W | AB | CB-8231 |
| R515 | 3.3K | 10% | 1/4W | AB | CB-3321 | R539 | 22 | 5% | 1/4W | AB | CB-2205 |
| R516 | 100 | 20% | 1/4W | AB | CB-1012 | R540 | 390 | 5% | 1/4W | AB | CB-3915 |
| R517 | 2.7K | 10% | 1/4W | AB | CB-2721 | R541 | 2.2K | 5% | 1/2W | AB | EB-2225 |
| R518 | 1K | 10% | 1/2W | AB | EB-1021 | R542 | 1K | 5% | 1/4W | AB | CB-1025 |
| R519 | 1K | 10% | 1/4W | AB | CB-1021 | R543 | 1.8K | 10% | 1/4W | AB | CB-1821 |
| R520 | 1K | 10% | 1/4W | AB | CB-1021 | R544 | 12K | 10% | 1/2W | AB | EB-1231 |
| R521 | 4.7K | 10% | 1/4W | AB | CB-4721 | R545 | 1.5K | 10% | 1/4W | AB | CB-1521 |
| R522 | 680 | 10% | 1/4W | AB | CB-6811 | R546 | 4.7K | 10% | 1/4W | AB | CB-4721 |
| R523 | 4.7K | 10% | 1/4W | AB | CB-4721 | R547 | 220K | 10% | 1/4W | AB | CB-2241 |
| R524 | 1K | 10% | 1/4W | AB | CB-1021 | R548 | 1.8K | 5% | 1/2W | AB | EB-1825 |

## CAPACITORS

| Symbol | Description | | | Mfr. | Part No. | Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| C501 | 0.0047mf | 10% | 100V | CD | WMF1D47 | C507 | 180pf | 10% | 500V | EL | DM15C181K |
| C502 | 22pf | 10% | 500V | EL | DM15C220K | C508 | 0.01mf | 10% | 100V | CD | WMF1S1 |
| C503 | .022mf | 10% | 100V | CD | WMF1S22 | C509 | 0.0056mf | 10% | 100V | CD | WMF1D56 |
| C504 | .1mf | 10% | 100V | CD | WMF1P1 | C510 | 0.47mf | 10% | 100V | ELP | Z1X474K |
| C505 | 3mf | 10% | 100V | ELP | Z1X305K | C511 | 0.33mf | 10% | 100V | ELP | Z1X334K |
| C506 | 0.002mf | 10% | 100V | CD | WMF1D22 | | | | | | |

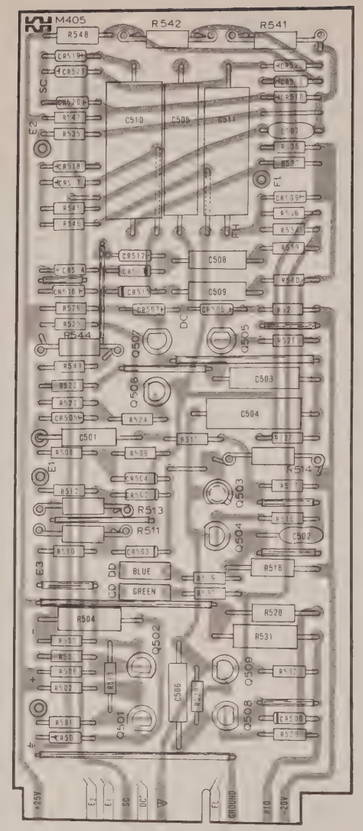
## TRANSISTORS, DIODES, & MISC.

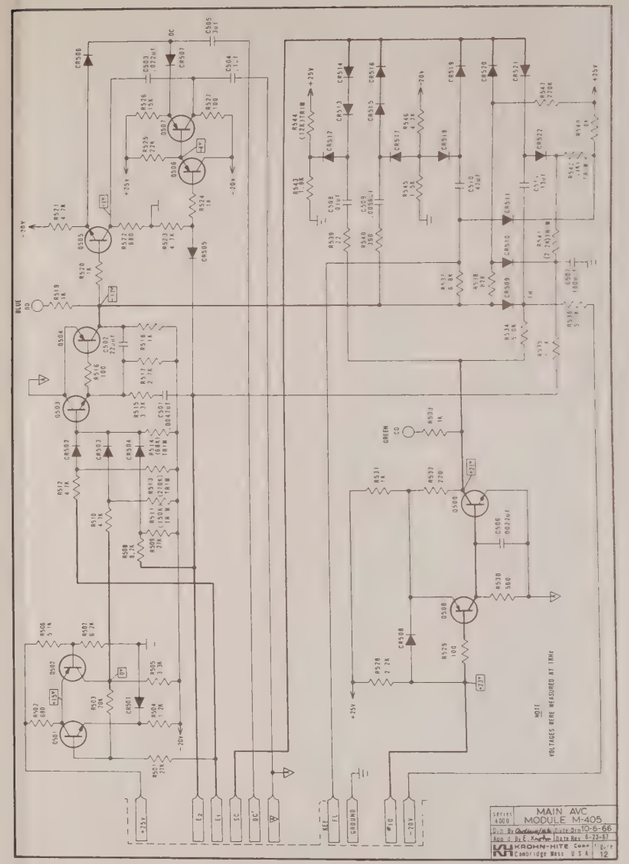
| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q501 | 2N3711 | TI | 2N3711 |
| Q502 | 2N3703 | TI | 2N3703 |
| Q503 | ~~MM3000-2~~ | Mot | ~~MM3000-2~~ |
| Q504 | 2N3702 | TI | 2N3702 |
| Q505 | 2N3708 | TI | 2N3708 |
| Q506 | 2N3702 | TI | 2N3702 |
| Q507 | 2N3702 | TI | 2N3702 |
| Q508 | 2N3702 | TI | 2N3702 |
| Q509 | 2N3704 | TI | 2N3704 |
| CR501 | 1N456 | Trans | 1N456 |
| CR502 | SG5445 | Trans | SG5445 |
| CR503 | SG5445 | Trans | SG5445 |
| CR504 | SG5445 | Trans | SG5445 |
| CR505 | 1N456 | Trans | 1N456 |
| CR506 | 1N456* | Trans | 1N456* |
| CR507 | 1N456* | Trans | 1N456* |
| CR508 | SG5445 | Trans | SG5445 |
| CR509 | 1N456 | Trans | 1N456 |
| CR510 | 1N456 | Trans | 1N456 |
| CR511 | 1N456 | Trans | 1N456 |
| CR512 | 1N456 | Trans | 1N456 |
| CR513 | SG5445 | Trans | SG5445 |
| CR514 | 1N456* | Trans | 1N456* |
| CR515 | SG5445 | Trans | SG5445 |
| CR516 | 1N456* | Trans | 1N456* |
| CR517 | 1N456 | Trans | 1N456 |
| CR518 | 1N456 | Trans | 1N456 |
| CR519 | 1N456* | Trans | 1N456* |
| CR520 | 1N456* | Trans | 1N456* |
| CR521 | 1N456* | Trans | 1N456* |
| CR522 | 1N456 | Trans | 1N456 |

*Selected for 0.1 nanoampere leakage

## MANUFACTURERS CODE

| | | | | | |
|---|---|---|---|---|---|
| A-B | Allen-Bradley Co. | Milwaukee, Wis. | TRANS | Transitron Electric Corp. | Wakefield, Mass. |
| C-D | Cornell-Dubilier Elec. | Newark, N.J. | MOT | Motorola Semiconductor | Phoenix, Arizona |
| EL | Electro Motive Mfg. Inc. | Willimantic, Conn. | ELP | Elpac Inc. | Fullerton, California |
| TI | Texas Instruments, Inc. | Dallas, Texas | | | |



## RESISTORS

| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| R601 | 649 | 1% | 1W | IRC | AS-1 |
| R602 | Trim | | 1/2W | IRC | CEC-TO |
| R603 | 10K | 1% | 1/2W | IRC | CEC-TO |
| R604 | 10K | 5% | 1/4W | AB | CB-1035 |
| R605 | Trim | | 1/4W | IRC | CEC-TO |
| R606 | 10K | 1% | 1/2W | IRC | CEC-TO |
| R607 | 15K | 5% | 1/4W | AB | CB-1535 |
| R608 | 1K | 5% | 1/4W | AB | CB-1025 |
| R609 | 5.6K | 10% | 1/2W | AB | EB-5621 |
| R610 | 237 | 1% | 1/2W | IRC | CEC-TO |
| R611 | 43.2K | 1% | 1/2W | IRC | CEC-TO |
| R612 | Trim | | 1W | IRC | AS-1 |
| R613 | 93 | 1% | 1W | IRC | AS-1 |
| R614 | 130K | 5% | 1/4W | AB | CB-1345 |
| R615 | 2.4K | 1% | 1W | IRC | AS-1 |
| R616 | 1.78K | 1% | 1W | IRC | AS-1 |
| R617 | 1.15K | 1% | 1W | IRC | AS-1 |
| R618 | 1.5K | 1% | 1W | IRC | AS-1 |
| R619 | 130K | 1% | 1/2W | IRC | CEC-TO |
| R620 | 43.2K | 1% | 1W | IRC | CEC-TO |
| R621 | 3.92K | 1% | 1/2W | IRC | CEC-TO |
| R622 | ZT | 10% | 1/4W | AB | CB-2701 |
| R623 | 3.09K | 1% | 1/2W | IRC | CEC-TO |
| R624 | 1.5K | 1% | 1/2W | IRC | CEC-TO |
| R625 | 1K | 10% | 1/4W | AB | CB-1021 |
| R626 | 6.8K | 5% | 1/4W | AB | CB-6825 |
| R627 | 68K | 10% | 1/4W | AB | CB-6831 |
| R628 | 10K | 5% | 1/4W | AB | CB-1035 |
| R629 | 1K | 10% | 1/4W | AB | CB-1021 |
| R630 | 2.7K | 1% | 1W | IRC | AS-1 |
| R631 | Trim | | 1W | IRC | AS-1 |
| R632 | 49 | 1% | 1W | IRC | AS-1 |
| R633 | 100 | 20% | 1/4W | AB | CB-1012 |
| R634 | 10K | 10% | 1/4W | AB | CB-1031 |
| R635 | 10K | 10% | 1/4W | AB | CB-1031 |
| R636 | 15K | 5% | 1/4W | AB | CB-1535 |
| R637 | 100K | 5% | 1/4W | AB | CB-1045 |
| R638 | 5.6K | 10% | 1/2W | AB | EB-5621 |
| R639 | 2.2K | 10% | 1/4W | AB | CB-2221 |
| R640 | 1K | 10% | 1/4W | AB | CB-1021 |
| R641 | 1K | 10% | 1/4W | AB | CB-1021 |
| R642 | 15K | 5% | 1/4W | AB | CB-1535 |
| R643 | 820K | 10% | 1/4W | AB | CB-8241 |
| R644 | 330 | 5% | 1/4W | AB | CB-3315 |
| R645 | 220K | 10% | 1/2W | AB | EB-2241 |
| R646 | 10K | 5% | 1/4W | AB | CB-1035 |
| R647 | 2K | 5% | 1/2W | AB | EB-2025 |
| R648 | 15K | 5% | 1/4W | AB | CB-1535 |
| R649 | 7.5K | 5% | 1/4W | AB | CB-7525 |
| R650 | 2K | 5% | 1/4W | AB | CB-2025 |
| R651 | 15K | 10% | 1/4W | AB | CB-1531 |
| R652 | 22K | 10% | 1/2W | AB | EB-2231 |
| R653 | 2K | 5% | 1/4W | AB | CB-2025 |
| R654 | 7.5K | 5% | 1/4W | AB | CB-7525 |
| R655 | 5.6K | 10% | 1/4W | AB | CB-5621 |
| R656 | 5.6K | 10% | 1/4W | AB | CB-5621 |
| R657 | 75 | 5% | 1/4W | AB | CB-7505 |
| R658 | 16K | 5% | 1/4W | AB | CB-1635 |
| R659 | 3.3K | 10% | 1/4W | AB | CB-3321 |
| R660 | 10K | 5% | 1/4W | AB | CB-1035 |
| R661 | 8.2K | 5% | 1/4W | AB | CB-8225 |
| R662 | 4.3K | 5% | 1/4W | AB | CB-4325 |
| R663 | 5.1K | 5% | 1/4W | AB | CB-5125 |
| R664 | ZZ0 | 10% | 1W | AB | GB-2211 |
| R665 | 820 | 10% | 1W | AB | GB-8211 |
| R666 | 32K | 1% | 1/4W | IRC | CEB-TO |

## CAPACITORS

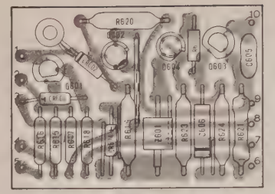
| Symbol | Description | | | Mfr. | Part No. |
|---|---|---|---|---|---|
| C601 | 2.5-11pf | | | ERIE | 536-006N300 B2PO-90R |
| C602 | (TRIM) 51pf | 5% | 500V | E1 | DM15C510J |
| C603 | 0.47mf | 10% | 100V | ELP | Z1X474K |
| C604 | (TRIM) 51pf | 5% | 500V | E1 | DM15C510J |
| C605 | 10pf | 10% | 500V | E1 | DM15C100K |
| C606 | 0.0022mf | 10% | 100V | C-D | WMF1D22 |
| C607 | 10pf | 5% | 500V | EL | DM15C100K |
| C608 | 470pf | 10% | 500V | E1 | DM15C471K |
| C609 | 10pf | 10% | 500V | EL | DM15C100K |
| C610 | 22pf | 10% | 500V | E1 | DM15C220K |
| C611 | 100pf | 10% | 500V | E1 | DM15C101K |
| C612 | 100pf | 10% | 500V | E1 | DM15C101K |
| C613 | 220pf | 10% | 500V | E1 | DM15C221K |
| C614 | 1mf | 20% | 35V | SP | 150D105X0035A2 |

## TRANSISTORS, DIODES, & MISC.

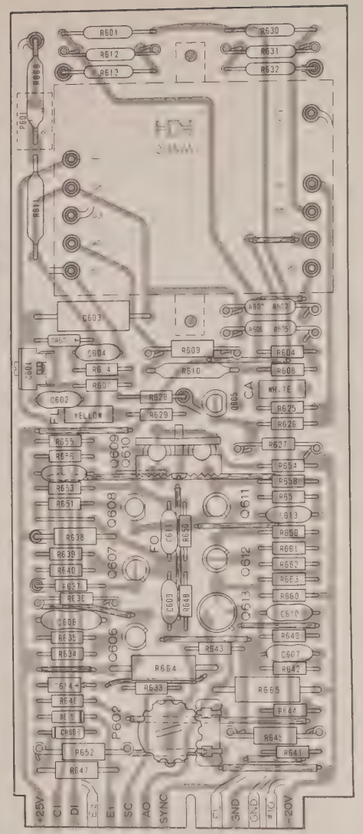
| Symbol | Description | Mfr. | Part No. |
|---|---|---|---|
| Q601 | 2N3702 | TI | 2N3702 2N4919 |
| Q602 | ~~MM2000-2~~ 2N4919 | Mot | ~~MM2000-2~~ |
| Q603 | 2N3711 | TI | 2N3711 |
| Q604 | MM2005-2 | Mot | MM2005-2 |
| Q605 | 2N3711 | TI | 2N3711 |
| Q606 | F1088A | UC | F1088A |
| Q607 | MM2005-2 | Mot | MM2005-2 |
| Q608 | 2N3640 | Fair | 2N3640 |
| Q609 | 2N3711 | TI | 2N3711 |
| Q610 | 2N3711 | TI | 2N3711 |
| Q611 | MM2005-2 | Mot | MM2005-2 |
| Q612 | MM2005-2 | Mot | MM2005-2 |
| Q613 | 40315 | RCA | 40315 |
| CR601 | 1N456 | Trans | 1N456 |
| CR602 | SG5445 | Trans | SG5445 |
| CR603 | 1N456 | Trans | 1N456 |
| CR604 | 1N456 | Trans | 1N456 |
| CR605 | SG5445 | Trans | SG5445 |
| CR606 | SG5445 | Trans | SG5445 |
| Z601 | 1N2163 | SEM | 1N2163 |
| P601 | 5K 30% 1/4W | IRC | 106-2 |
| P602 | 25K 30% 1/4W | CTS | U201R253B |

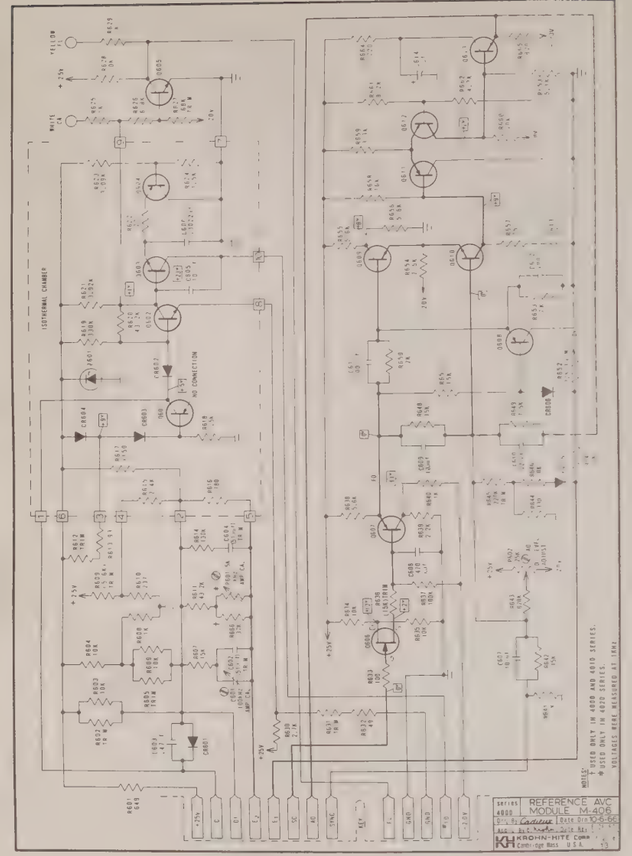
## MANUFACTURERS CODE

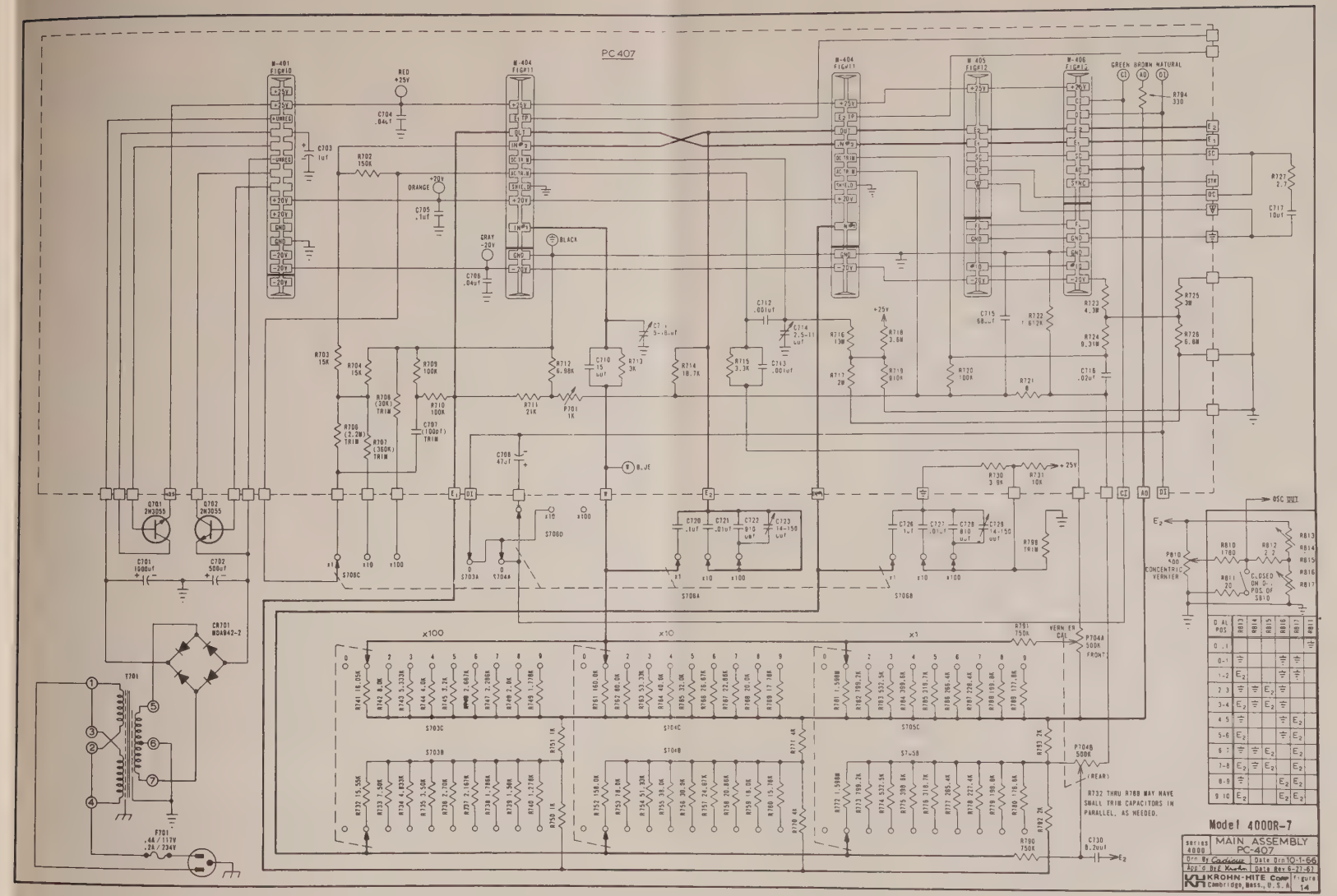
| | | | |
|---|---|---|---|
| A-B | Allen-Bradley Co. | Milwaukee, Wis. | |
| CTS | CTS Corp. | Elkhart, Ind. | |
| EL | Electro Motive Mfg. Inc. | Willimantic, Conn. | |
| FAIR | Fairchild Semiconductor | San Rafael, Calif. | |
| IRC | International Resistance Co. | Philadelphia, Pa. | |
| RCA | Radio Corporation of America | Harrison, N.J. | |
| SEM | U. S. Semcor | Phoenix, Arizona | |
| SP | Sprague Electric Co. | North Adams, Mass. | |
| TI | Texas Instruments, Inc. | Dallas, Texas | |
| TRANS | Transitron Electric Corp. | Wakefield, Mass. | |
| MOT | Motorola Semiconductor | Phoenix, Arizona | |
| UC | Union Carbide Electronics | Mountain View, Calif. | |
| ELP | Elpac, Inc. | Fullerton, Calif. | |
| ERIE | Erie Products Inc. | Erie, Pa. | |

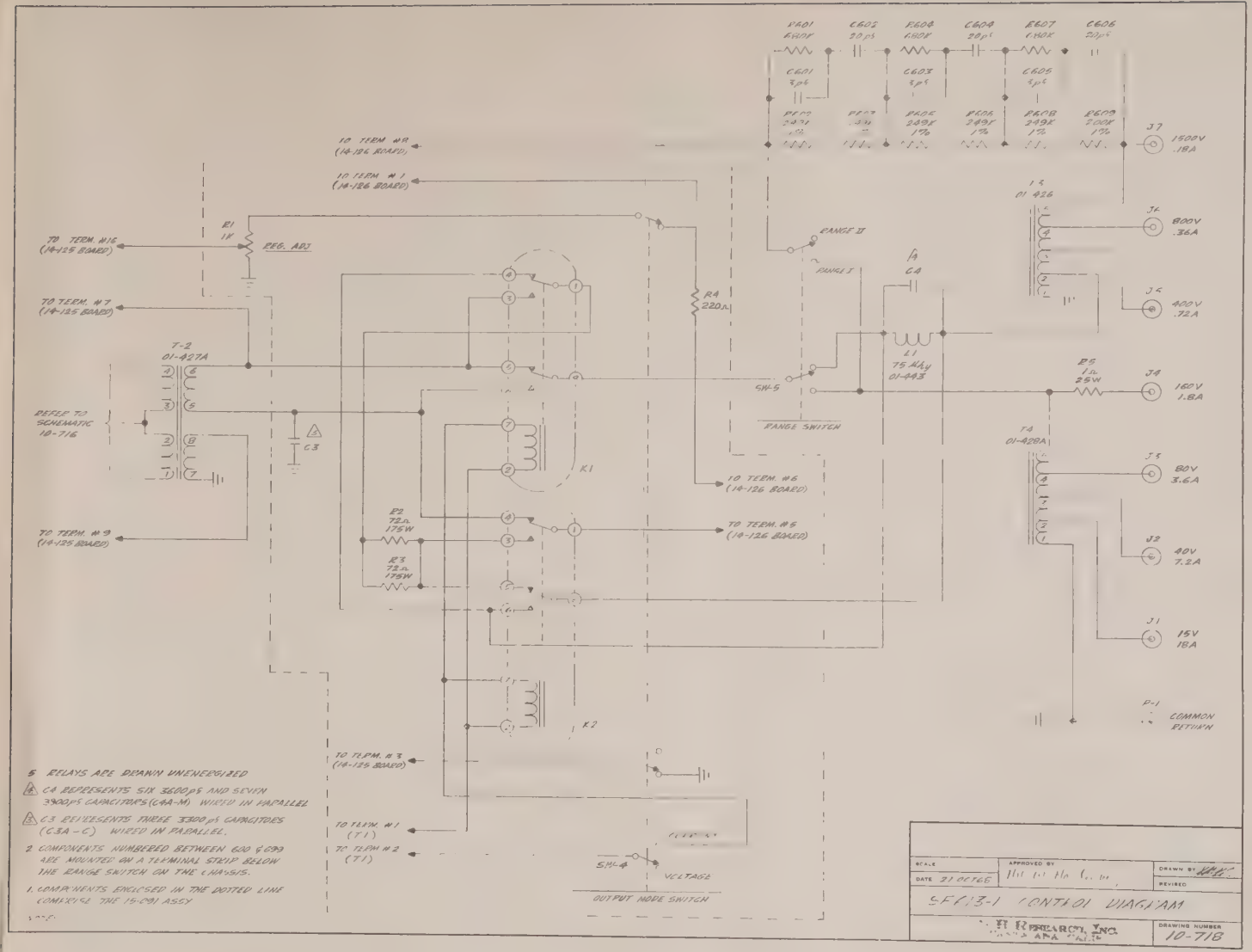


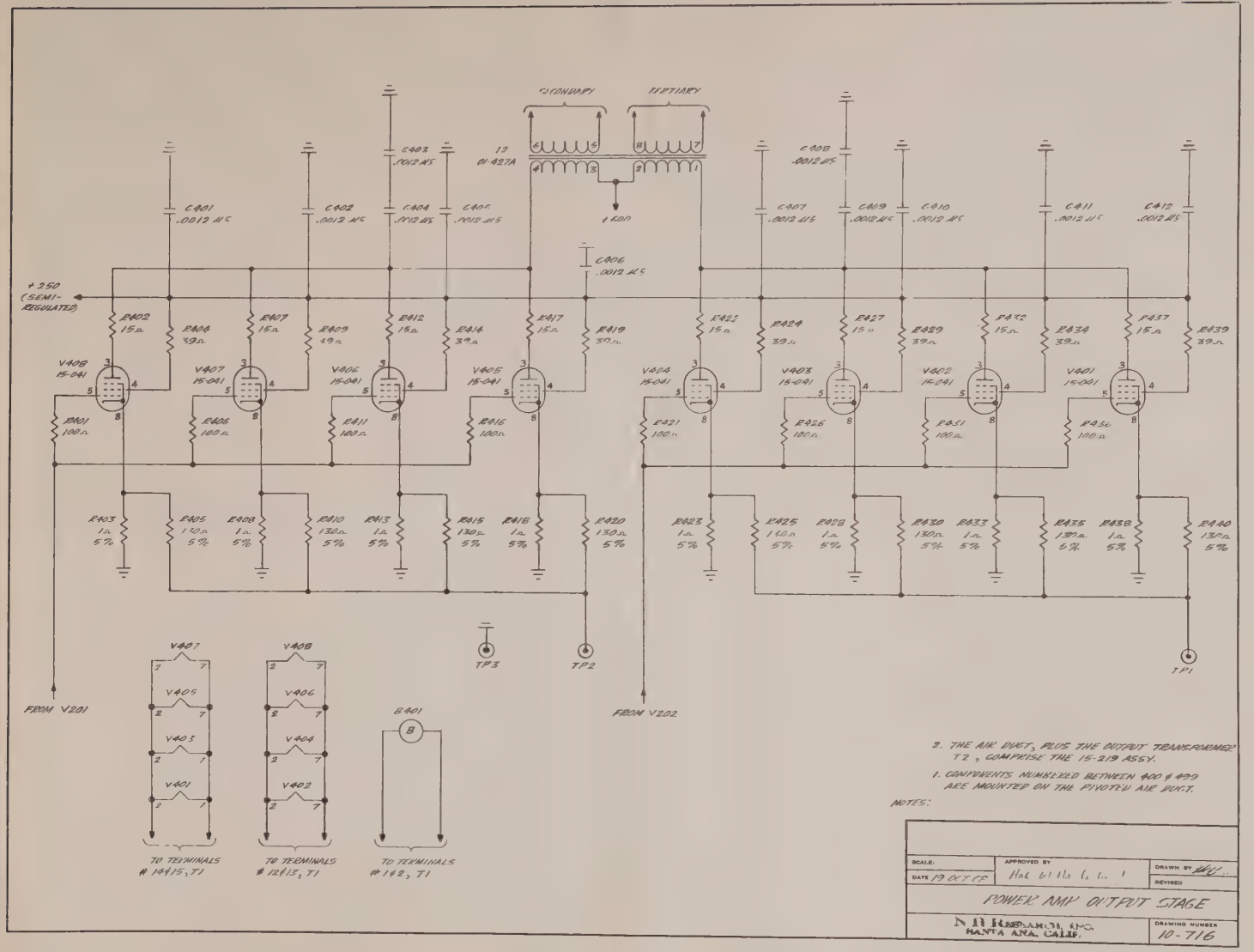
PC408






PC 407
M-401 FIG#10
M-404 FIG#11
M-404 FIG#12
M-405 FIG#12
M-406 FIG#12
GREEN BROWN NATURAL
RED +25V
ORANGE +20V
GRAY -20V
BLACK
C704 .04uf
C705 .1uf
C706 .04uf
C703 1uf
R702 150K
R794 330
R722 2.7
C717 10uf
R725 2M
R726 6.8M
R723 4.3M
R724 9.31M
C716 .02uf
R721
R720 100K
C715 68uf
R722 6.72K
C712 .001uf
C713 .001uf
C714 2.5-11 uuf
C711 5-18uf
R716 13M
R717 2M
R718 3.8M
R719 810K
R715 3.3K
R714 18.7K
R713 3K
C710 15 uuf
R712 6.98K
R711 24K
P701 1K
R703 15K
R704 15K
R705 (2.2M) TRIM
R706 (30K) TRIM
R707 (360K) TRIM
R709 100K
R710 100K
C707 (100pf) TRIM
C708 47uf
B.JE
S708D
S708C
S708A
S708B
S703A
S704A
x10
x100
x1
C720 .1uf
C721 .01uf
C722 810 uuf
C723 14-150 uuf
C726 .1uf
C727 .01uf
C728 810 uuf
C729 14-150 uuf
R730 3.9K
R731 10K
+25V
R798 TRIM
Q701 2N3055
Q702 2N3055
C701 1900uf
C702 500uf
CR701 MDA942-2
T701
F701 .44/117V .2A/234V
x100
x10
x1
S703C
S704C
S705C
S703B
S704B
S705B
R791 750K
VERN E9 CAL
P704A 500K FRONT
P704B 500K (REAR)
R793 7K
R790 750K
C730 0.2uf
R732 THRU R788 MAY HAVE SMALL TRIM CAPACITORS IN PARALLEL, AS NEEDED.
OSC UNIT
P810 400 CONCENTRIC VERNIER
R811 75
R810 180
R812 2.2
R813
R814
R815
R816
R817
CLOSED ON 0-1 POS OF S810
D AL POS
Model 4000R-7
series 4000
MAIN ASSEMBLY PC-407
Drn By Carriere
Date Drn 10-1-66
App'd Ref Mark
Date Rev 5-27-67
KROHN-HITE Corp
Cambridge, Mass., U.S.A.
Figure 14


R601 6.49K
C601 3pf
R602 249K 1%
C602 20pf
R603 7.00K 1%
R604 6.49K
C603 3pf
R605 249K 1%
C604 20pf
R606 249K 1%
R607 1.49K
C605 3pf
R608 249K 1%
C606 20pf
R609 7.00K 1%
J7 1500V .18A
J6 800V .36A
J5 400V .72A
J4 160V 1.8A
J3 80V 3.6A
J2 40V 7.2A
J1 15V 18A
P-1 COMMON RETURN
T5 01-426
T4 01-428A
T3 01-427A
T2 01-427A
T1 01-443
L1 75 MHy
C4
C3
R1 1K REG. ADJ
R2 72Ω 175W
R3 72Ω 175W
R4 220Ω
R5 1Ω 25W
K1
K2
RANGE I
RANGE II
RANGE SWITCH
SW-5
SW-4
VOLTAGE
OUTPUT MODE SWITCH
TO TERM. #16 (14-125 BOARD)
TO TERM. #7 (14-125 BOARD)
TO TERM. #9 (14-125 BOARD)
REFER TO SCHEMATIC 10-716
TO TERM. #8 (14-126 BOARD)
TO TERM. #1 (14-126 BOARD)
TO TERM. #6 (14-126 BOARD)
TO TERM. #6 (14-126 BOARD)
TO TERM. #3 (14-125 BOARD)
TO T1 PRI. #1 (T1)
TO T1 PRI. #2 (T1)
5 RELAYS ARE SHOWN UNENERGIZED
4 C4 REPRESENTS SIX 3600pf AND SEVEN 3900pf CAPACITORS (C4A-M) WIRED IN PARALLEL
3 C3 REPRESENTS THREE 3300pf CAPACITORS (C3A-C) WIRED IN PARALLEL.
2 COMPONENTS NUMBERED BETWEEN 600 & 699 ARE MOUNTED ON A TERMINAL STRIP BELOW THE RANGE SWITCH ON THE CHASSIS.
1 COMPONENTS ENCLOSED IN THE DOTTED LINE COMPRISE THE 15-091 ASSY
SCALE
DATE 27 OCT 65
APPROVED BY
DRAWN BY
REVISED
SERIES-1 CONTROL DIAGRAM
DRAWING NUMBER 10-718




2. THE AIR DUCT, PLUS THE OUTPUT TRANSFORMER T2, COMPRISE THE 15-219 ASSY.

1. COMPONENTS NUMBERED BETWEEN #400 & #499 ARE MOUNTED ON THE PIVOTED AIR DUCT.

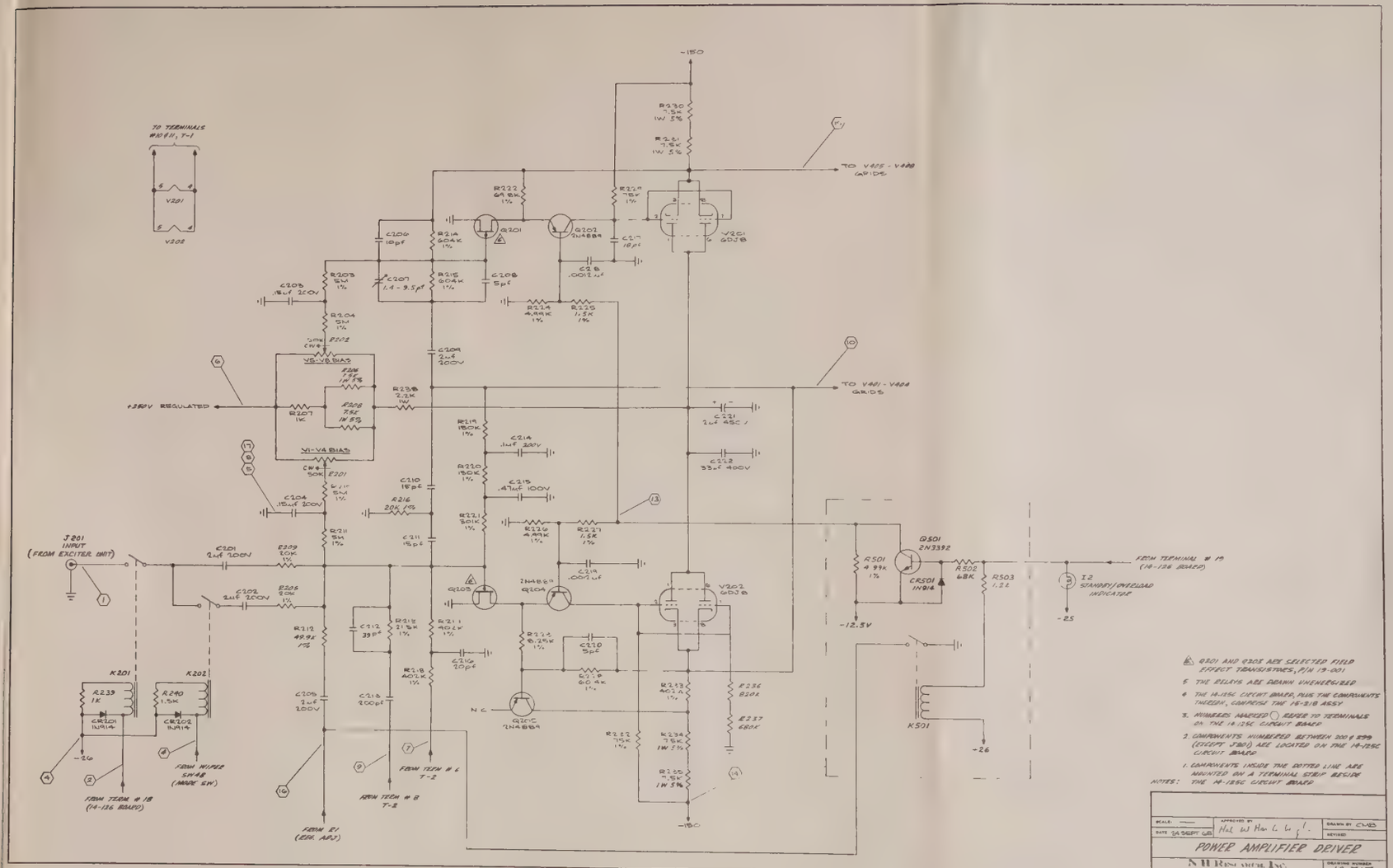
NOTES:

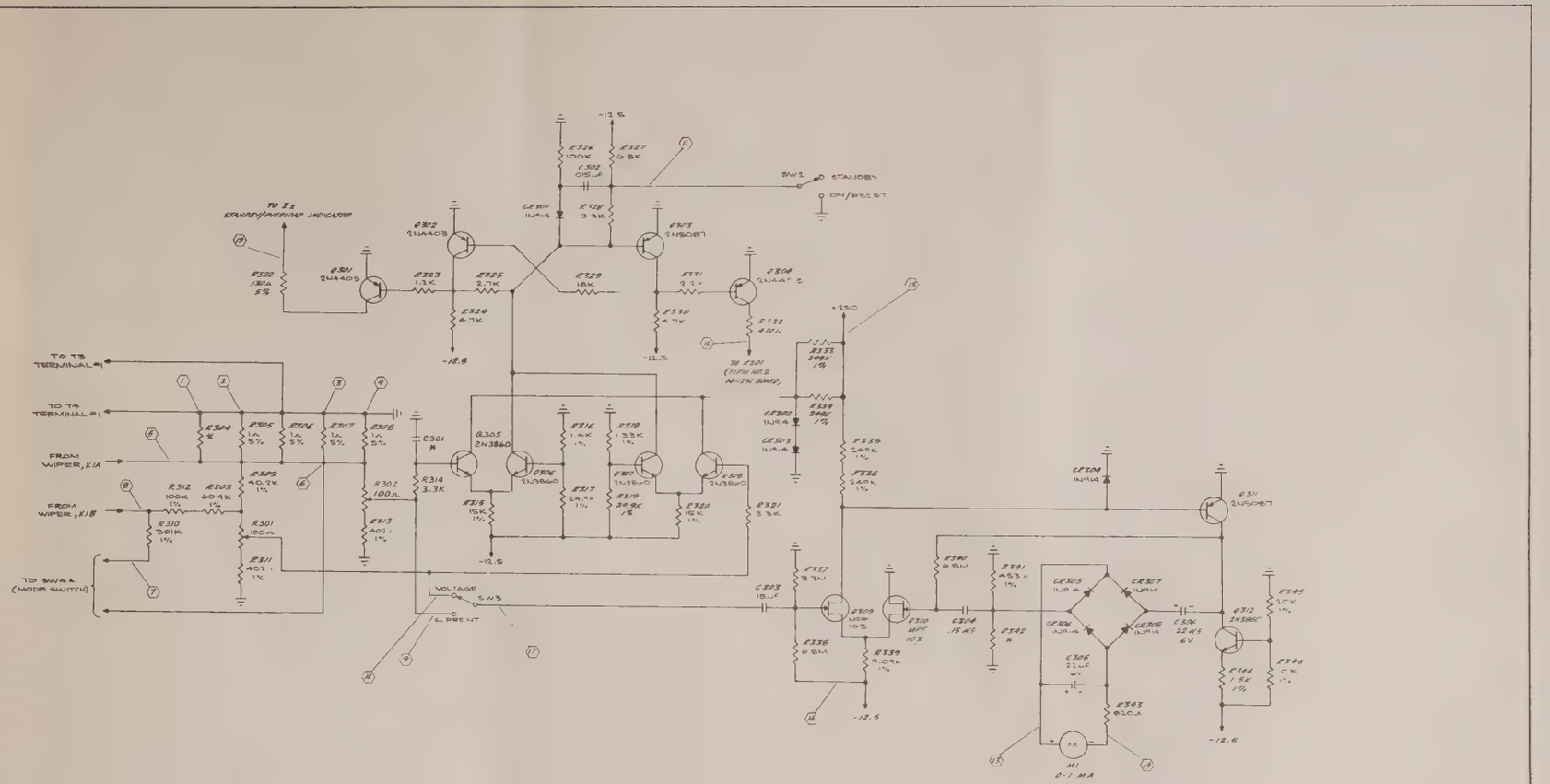
| | | |
|---|---|---|
| SCALE: | APPROVED BY Hal Wills | DRAWN BY |
| DATE 19 OCT 56 | | REVISED |

POWER AMP OUTPUT STAGE

H. H. SCOTT, INC. MANTA ANA, CALIF.

DRAWING NUMBER 10-716


-150
TO TERMINALS #10 & 11, T-1
V201
V202
R230 7.5K 1W 5%
R231 7.5K 1W 5%
TO V405 - V408 GRIDS
R222 69.8K 1%
R227 7.5K 1%
Q201
Q202 2N4884
V201 6DJ8
C206 10pf
R214 604K 1%
C207 1.4 - 9.5pf
R215 604K 1%
C208 5pf
C27 18pf
C28 .0012uf
C205 .15uf 200V
R203 5M 1%
R204 5M 1%
R224 4.99K 1%
R225 1.5K 1%
50K CW-E202
V5-V8 BIAS
C209 2uf 300V
R206 7.5K 1W 5%
R208 7.5K 1W 5%
R207 1K
+380V REGULATED
R238 2.2K 1W
TO V401 - V404 GRIDS
C231 2uf 450V
C232 33uf 400V
R219 180K 1%
C214 .1uf 200V
R220 180K 1%
C215 .47uf 100V
V1-V4 BIAS
50K CW-E201
C204 .15uf 200V
C210 18pf
R216 20K 1%
R221 301K 1%
R226 4.99K 1%
R227 1.5K 1%
C211 15pf
C219 .0012uf
R211 5M 1%
J201 INPUT (FROM EXCITER UNIT)
C201 2uf 200V
R209 20K 1%
C202 2uf 200V
R205 50K 1%
Q203 2N4884
Q204
V202 6DJ8
R501 4.99K 1%
Q501 2N3392
R502 68K
R503 1.2Ω
CR501 1N914
I2 STANDBY/OVERLOAD INDICATOR
FROM TERMINAL # 19 (14-126 BOARD)
-12.5V
-25
C212 39pf
R212 49.9K 1%
R213 21.5K 1%
R211 402K 1%
C216 20pf
R223 6.25K 1%
C220 5pf
R228 402K 1%
R229 60.4K 1%
R233 402K 1%
R236 820Ω
R237 680Ω
N.C.
Q205 2N4884
K201
K202
R239 1K
R240 1.5K
CR201 1N914
CR202 1N914
-26
FROM WIPER SW4B (MAKE SW)
FROM TERM # 18 (14-126 BOARD)
FROM TERM # 6 T-2
FROM TERM # 8 T-2
FROM R1 (ERR. ADJ.)
K501
R232 7.5K 1%
R234 7.5K 1W 5%
R235 7.5K 1W 5%
-150
Q201 AND Q205 ARE SELECTED FIELD EFFECT TRANSISTORS, P/N 19-001
5. THE RELAYS ARE DRAWN UNENERGIZED
4. THE 14-126 CIRCUIT BOARD, PLUS THE COMPONENTS THEREON, COMPRISE THE 16-318 ASSY
3. NUMBERS MARKED ◯ REFER TO TERMINALS ON THE 14-126 CIRCUIT BOARD
2. COMPONENTS NUMBERED BETWEEN 200 & 299 (EXCEPT J201) ARE LOCATED ON THE 14-126 CIRCUIT BOARD
1. COMPONENTS INSIDE THE DOTTED LINE ARE MOUNTED ON A TERMINAL STRIP BESIDE THE 14-126 CIRCUIT BOARD
NOTES:
SCALE: ——
APPROVED BY
DRAWN BY C.V.D.
DATE 24 SEPT 68
REVISED
POWER AMPLIFIER DRIVER
NTR ELECTRONICS, INC. SANTA ANA, CALIF.
DRAWING NUMBER 10-717




NOTES:

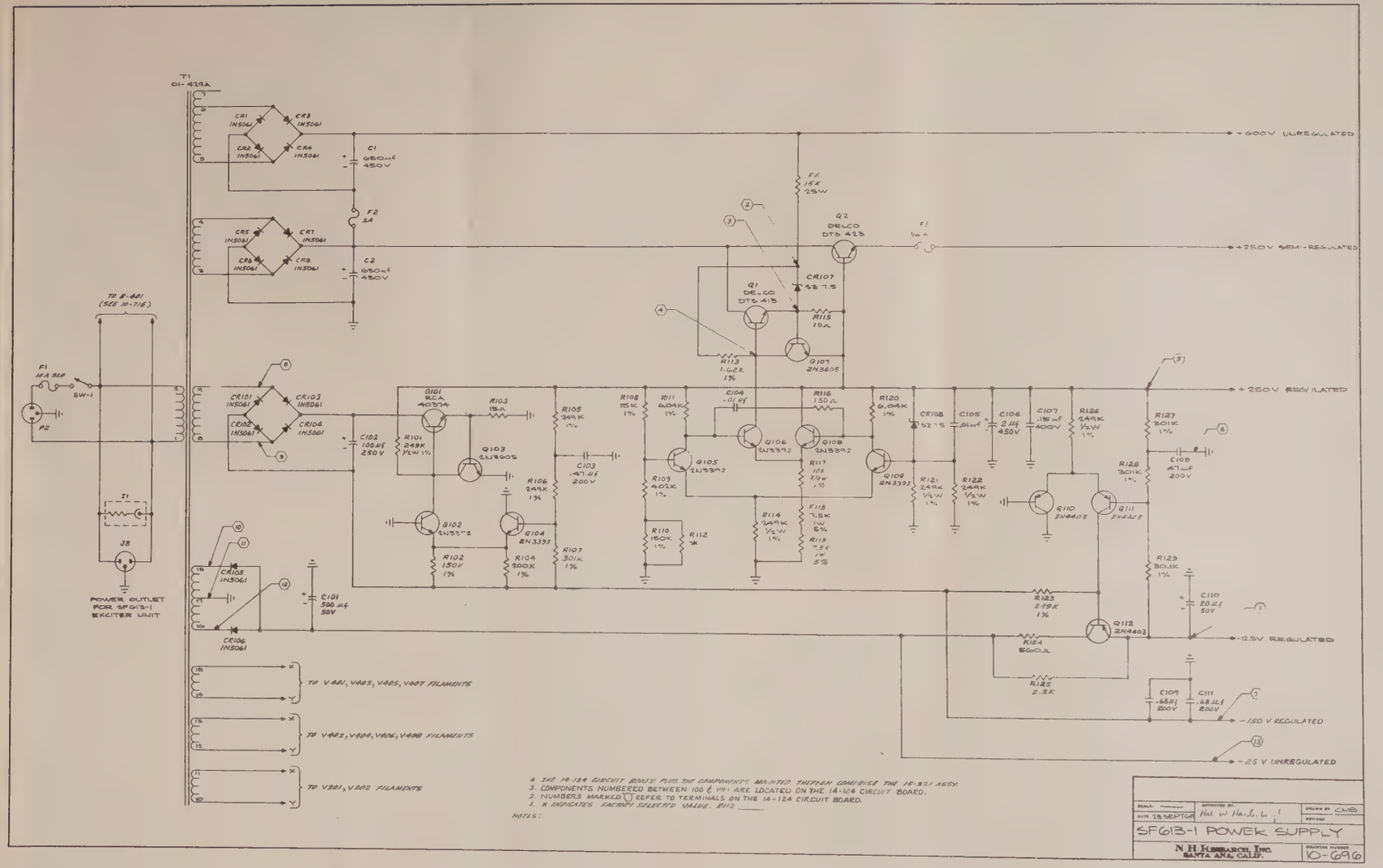
4. THE COMPONENTS SHOWN ON THIS SCHEMATIC COMPRISE THE 15-068 ASSY & THE 16-088 ASSY.
3. COMPONENTS NUMBERED BETWEEN 300 & 399 ARE LOCATED ON THE M-126 CIRCUIT BOARD.
2. NUMBERS MARKED ⬡ REFER TO TERMINALS ON THE 10-126 CIRCUIT BOARD.
1. X INDICATES FACTORY SELECTED VALUE, AS REQD. C301 _____, R304 _____, R343 _____

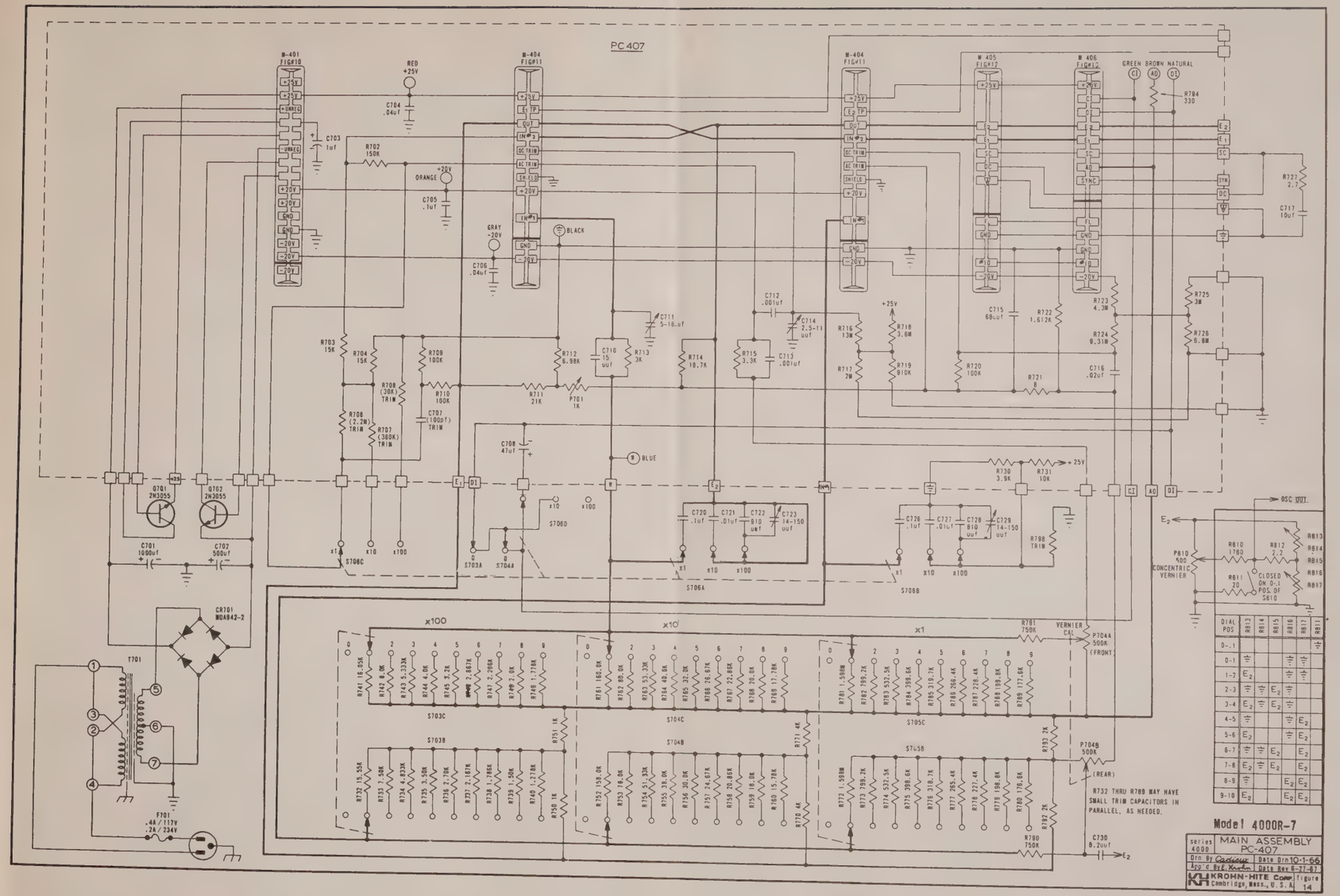
| | | |
|---|---|---|
| SCALE: | APPROVED BY: Hal W. Hoover, Jr. | DRAWN BY: CL-BL |
| DATE: 10-4-68 | | REVISED |

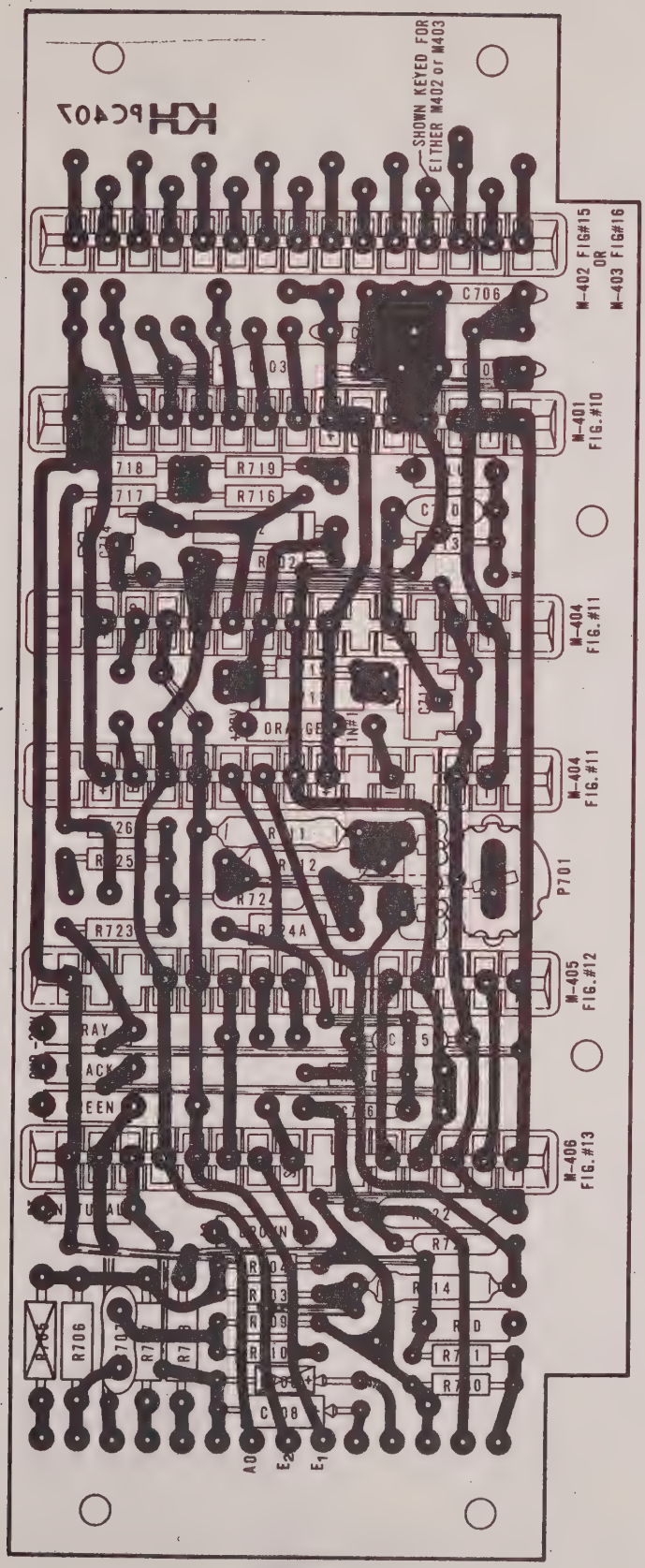
METERING & OVERLOAD CIRCUIT

NH Research Inc. SANTA ANA, CALIF.

DRAWING NUMBER 10-704


T1
01-4229A
CR1 IN5061
CR2 IN5061
CR3 IN5061
CR4 IN5061
C1 4850 MF 450V
F2 2A
CR5 IN5061
CR6 IN5061
CR7 IN5061
CR8 IN5061
C2 4850 MF 450V
+600V UNREGULATED
F4 15K 25W
Q2 DELCO DTS 423
F3 1/4 A
+250V SEMI-REGULATED
Q1 DELCO DTS 413
CR107 5Z 7.5
R115 10Ω
Q107 2N3605
R113 1.62K 1%
+250V REGULATED
TO E-601 (SEE 10-716)
F1 10A 3AB
SW-1
P2
I1
J8
POWER OUTLET FOR SF613-1 EXCITER UNIT
CR101 IN5061
CR102 IN5061
CR103 IN5061
CR104 IN5061
C102 100 MF 250 V
Q101 RCA 40574
R101 249K PLW 1%
R103 15Ω
Q103 2N3605
R105 249K 1%
C103 .47 MF 200V
R106 249K 1%
Q102 2N3392
Q104 2N3393
R102 150K 1%
R104 200K 1%
R107 301K 1%
R108 15K 1%
R111 604K 1%
C104 .01 MF
R116 150Ω
Q106 2N3392
Q105 2N3392
R109 402K 1%
R110 150K 1%
R112 *
Q108 2N3392
R117 10Ω 1/4W 1%
R114 249K 1/4W 1%
R118 7.5K 1W 5%
R119 7.5K 1W 5%
Q109 2N3392
R120 6.04K 1%
CR108 5Z 7.5
C105 .01 MF
R121 249K 1/4W 1%
R122 249K 1/4W 1%
C106 2 MF 450V
C107 .15 MF 400V
R126 249K 1/4W 1%
Q110 2N4403
Q111 2N4403
R127 301K 1%
R128 301K 1%
C108 .47 MF 200V
R123 249K 1%
Q112 2N4403
R124 560Ω
R125 2.2K
R129 30.1K 1%
C110 20 MF 50V
-12.5V REGULATED
C109 .68 MF 200V
C111 .68 MF 200V
-150 V REGULATED
-25 V UNREGULATED
CR105 IN5061
CR106 IN5061
C101 500 MF 30V
TO V401, V403, V405, V407 FILAMENTS
TO V402, V404, V406, V408 FILAMENTS
TO V201, V202 FILAMENTS
NOTES:
4. THE 14-124 CIRCUIT BOARD PLUS THE COMPONENTS MOUNTED THEREON COMPRISE THE 18-221 ASSY.
3. COMPONENTS NUMBERED BETWEEN 100 & 199 ARE LOCATED ON THE 14-124 CIRCUIT BOARD.
2. NUMBERS MARKED ⬡ REFER TO TERMINALS ON THE 14-124 CIRCUIT BOARD.
1. * INDICATES FACTORY SELECTED VALUE. R112 ____
SCALE: ——
DATE 18 SEPT 68
APPROVED BY Hal W Hall, Jr
DRAWN BY CJHB
REVISED
SF613-1 POWER SUPPLY
N H RESEARCH, INC. SANTA ANA, CALIF.
DRAWING NUMBER 10-696


PC 407
W-401 FIG#10
W-404 FIG#11
W-404 FIG#11
W 405 FIG#12
W 406 FIG#12
RED +25V
ORANGE +20V
GRAY -20V
BLACK
GREEN BROWN NATURAL
BLUE
C703 1uf
C704 .04uf
C705 .1uf
C706 .04uf
C707 (100pf) TRIM
C708 47uf
C709 5-18uuf
C710 15 uuf
C711 5-18uuf
C712 .001uf
C713 .001uf
C714 2.5-11 uuf
C715 68uf
C716 .02uf
C717 10uf
C720 .1uf
C721 .01uf
C722 810 uuf
C723 14-150 uuf
C726 .1uf
C727 .01uf
C728 810 uuf
C729 14-150 uuf
C730 8.2uuf
R702 150K
R703 15K
R704 15K
R708 (30K) TRIM
R709 100K
R710 100K
R708 (2.2M) TRIM
R707 (380K) TRIM
R711 21K
R712 6.98K
P701 1K
R713 3K
R714 18.7K
R715 3.3K
R716 13K
R717 2W
R718 3.6M
R719 910K
R720 100K
R721 8
R722 1.612K
R723 4.3M
R724 9.31M
R725 3M
R726 6.8M
R727 2.7
R730 3.9K
R731 10K
R732 THRU R789 MAY HAVE SMALL TRIM CAPACITORS IN PARALLEL, AS NEEDED.
R780 750K
R781 750K
VERNIER CAL
P704A 500K (FRONT)
P704B 500K (REAR)
R784 330
R788 TRIM
R792 2K
R793 2K
Q701 2N3055
Q702 2N3055
C701 1000uf
C702 500uf
CR701 WOA842-2
T701
F701 .4A/117V .2A/234V
S703A
S703B
S703C
S703D
S704A
S704B
S704C
S704D
S705A
S705B
S705C
S706A
S706B
S706C
S706D
x1
x10
x100
OSC OUT
P810 500 CONCENTRIC VERNIER
R810 178Ω
R811 20
R812 2.2
R813
R814
R815
R816
R817
CLOSED ON 0-1 POS. OF S810
DIAL POS
0-.1
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
Mode! 4000R-7
series 4000
MAIN ASSEMBLY PC-407
Drn By Cadieux
Date Drn 10-1-66
App'd By E. Krohn
Date Rev 6-27-67
KROHN-HITE Corp. Cambridge, Mass., U.S.A.
figure 14


PC407
SHOWN KEYED FOR EITHER M402 or M403
M-402 FIG#15 OR M-403 FIG#16
M-401 FIG.#10
M-404 FIG.#11
M-404 FIG.#11
M-405 FIG.#12
M-406 FIG.#13
C706
R719
R716
R723
P701
R706
ORANGE

## FEDERAL SUPPLY CODE FOR MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-2, Code to Name:

01121 Allen Bradley
Milwaukee, Wisconsin

01295 Texas Instruments, Inc.
Semiconductor Components Div.
Houston, Texas

03797 Eldema Corp.
El Monte, California

03877 Transitron Electronic Corp.
Wakefield, Mass.

04713 Motorola, Inc.
Semiconductor Products Div.
Phoenix, Arizona

05397 Union Carbide Corp. Linde
Division Kemet Dept.
Cleveland, Ohio

06751 U.S. Semcor Division of
Nuclear Corp. of America, Inc.
Phoenix, Arizona

07088 Kelvin Associates
Van Nuys, Calif.

07263 Fairchild Camera & Instrument Corp.
Fairchild Semiconductor Div.
Mountain View, Calif.

.2400 International Resistance Co.
Control Components Div.
Philadelphia, Pa.

.2406 Elpac, Inc.
Fullerton, Calif.

49671 Radio Corp. of America
New York, N.Y.

56289 Sprague Electric Co.
North Adams, Mass.

71400 Bussman Manufacturing
Div. of McGraw Edison Co.
St. Louis, Mo.

72136 Electro Motive Mfg. Inc.
Willimantic, Conn.

79727 Continental-Wirt Electronics
Philadelphia, Pa.

88140 Cutler-Hammer Inc.
Lincoln, Illinois

88419 Cornell-Dublier Elec. Corp.
Electro Mechanical Div.
Fuquay Springs, N.C.

88865 Krohn-Hite Corporation
Cambridge, Mass.

95146 Alco Electronics Mfg. Co.
Lawrence, Mass.

CHAPTER 3

SF 613-1 POWER UNIT

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SECTION 1

SPECIFICATIONS

GENERAL PURPOSE SINE WAVE AC POWER SOURCE

| | |
|---|---|
| Output Frequency Range: | 10Hz - 100KHz |
| Frequency Resolution: | Three digits above 100Hz (two digits 10Hz - 99Hz) with decimal ranging and vernier. |
| Frequency Accuracy: | ±1.0% of setting |
| Output Power: | 200 Watts at the following matched power points: |

| | |
|---|---|
| 1200V | (7200 ohms) |
| 600V | (1800 ohms) |
| 300V | ( 450 ohms) |
| 120V | ( 72 ohms) |
| 60V | ( 18 ohms) |
| 30V | ( 4.5 ohms) |
| 12V | ( .72 ohms) |

| | |
|---|---|
| Full Power Frequency Bandwidth: | 45Hz to 40KHz |
| Output Voltage with 100 ohm/V load: | 0 - 1500 volts minimum 60 - 50KHz<br>0 - 1000 volts minimum, from 35Hz up. |
| Voltage Ranging: | taps at 1500V<br>800V<br>400V<br>160V<br>80V<br>40V<br>15V |

| | |
|---|---|
| Voltage Controls: | Five digit ratio transformer, plus a decade voltage attenuator and ten-turn vernier. |
| VOLTAGE STABILITY,* (after 2½ hr. warmup): | |
| Vs. line: | ±0.01% for 115V ±10V line |
| Vs. time: ** | ±20 ppm/2 minutes<br>±50 ppm/hr. |

*Measurements made with an average sensing voltmeter at midband ** and constant temperature.

| | |
|---|---|
| Load Regulation: | Adjustable by front panel control. |
| Distortion: | 0.05% max THD, 50 Hz to 10KHz, degrading to 1% at 100KHz. |
| Residual Hum and Noise: | -86 db |

CONSTANT CURRENT MODE:

| | | | |
|---|---|---|---|
| Current Ranges | 18A | into | 0.18 ohm or less |
| | 7.2A | into | 1.125 ohm or less |
| | 3.6A | into | 4.5 ohm or less |
| | 1.8A | into | 18 ohm or less |
| | .72A | into | 112.5 ohm or less |
| | .36A | into | 450 ohm or less |
| | .18A | into | 1800 ohm or less |

| | |
|---|---|
| Current Regulation: | Adjustable by front panel control. |
| Overvoltage/Overcurrent Protection: | Automatic with manual reset. |
| On/Standby Switch: | Front panel control allows output to be turned off without turning off primary power. |
| Construction: | All silicon solid state except for power output stages. |

MODEL SF 613-1 (Cont'd.)

| | |
|---|---|
| Line Power: | 115V ±10V, 60 Hz |
| Metering: | Front panel mounted to monitor either output voltage or current. |
| Physical: | Two standard 19" rack panels<br>15-3/4" total height<br>18" deep<br>135 lbs. approximately. |

SECTION 2 OPERATING INSTRUCTIONS

MODEL SF 613-1 POWER UNIT

2.0 Controls

2.0.1 Power Switch: Turns power unit and exciter unit on and off. A power-on indicator lamp is located above the power switch on the front panel.

2.0.2 Output Mode Switch: This two-position switch determines whether the output is to be regulated as a constant voltage or as a constant current.

2.0.3 On/Reset-Standby Switch: This two-position switch has a dual function: In the standby position, the output is disabled by removing the signal while line power is kept on. The standby/overload indicator lamp is on in the standby position. In the on/reset position, the signal is connected for normal operation. In the event of an overload, caused by either excessive output current or excessive output voltage, the standby/overload indicator lamp will turn on and the signal will be removed automatically. To restore normal operation after correcting the difficulty, it is necessary to first operate the switch to standby and then to on/reset position. This will connect the signal and turn off the standby/overload indicator lamp. Whenever this lamp is lit, it indicates that either the standby or overload condition exists.

2.0.4 Regulation Adjust: This potentiometer control provides a variable source of positive current feedback to compensate for loading effect in the voltage mode, while in the current mode it provides a variable source of positive voltage feedback to compensate for changes in external resistance.

2.0.5 RANGE I - RANGE II Switch: This two-position switch selects either of two output ranges as follows: in RANGE I, output is available in the voltage mode at the 15V, 40V, 80V and 160V receptacles and in the current mode 18A, 7.2A, 3.7A and 1.8A outputs are available at the same set of receptacles (J1, J2, J3 and J4). In RANGE II, output is available in the voltage mode at the 400V, 800V and 1500V receptacles and in the current mode .72A, .36A and .18A outputs are available at the same

set of receptacles (J5, J6 and J7). Each receptacle is proveded with code symbols to indicate the appropriate meter ranges to be used for monitoring the voltage and current output levels.

2.0.6 Fuses: The following three fuses are located on the top flange of the rear panel. To remove fuses, it is necessary to remove the top cover from the power unit.

| | | |
|---|---|---|
| 1. | Primary Power Fuse | 10A slo-blo FNM |
| 2. | Screen Grid Fuse | ¼A fast-blo AGC |
| 3. | Plate Fuse | 2A fast-blo BBS |

2.1 Operation

2.1.1 Voltage Mode: With the standby switch in standby position, select the desired operating frequency. Any desired voltage 0 - 160V RMS can be obtained on RANGE I at the 160V receptacle or one of the lower voltage receptacles (80V, 40V, 15V) depending upon the loading or other conditions involved. The optimum operating level (on the 160V tap) where full rated power can be obtained, is 120V RMS, at which point a 72 ohm load will dissipate 200W at any frequency within the specified bandwidth. At 60V RMS on the 80V tap, 18 ohms; at 30V on the 40V tap, 4.5 ohms; and at 12V on the 15V tap, 0.72 ohms are optimum loads. To obtain the lowest noise level and best resolution of adjustment, it is advisable to use the lowest voltage range that will give the desired output voltage. Any desired voltage 0 - 1500V RMS can be obtained from RANGE II at the 1500V, 800V or 400V receptacles, depending upon the loading or other conditions involved. The optimum operating level on the 1500V tap where full rated power can be obtained is 1200V RMS at which point a 7200 ohm load will dissipate 200W at any frequency within the specified bandwidth. At 600V on the 800V tap, 1800 ohms and at 300V on the 400V tap, 450 ohms are the optimum loads. For personal safety and operating convenience, it is advisable to keep the standby switch in the standby position when output voltage is not actually required as this power unit is capable of delivering lethal output levels!! To obtain output voltage, operate standby switch to on/reset position, and adjust exciter unit attenuator controls for desired output.

2.1.2 Current Mode: Caution! An appropriate external current path is required on the current mode! With standby switch in standby position, select the desired operating frequency. Any desired current 0 - 18 amps can be obtained on RANGE I at the 18A receptacle or one of the lower current receptacles (7.2A, 3.6A, 1.8A) depending upon external resistance or other conditions involved. The maximum external resistance for the 18A tap is 0.18 ohms; 7.2A tap - 1.125 ohms, 3.6A tap - 4.5 ohms, and for the 1.8A tap, 18 ohms. Any desired current 0 - 0.72 amps can be obtained on RANGE II at the .72A receptacle or one of the lower current receptacles (.36A, .18A) depending upon external resistance or other conditions involved. The maximum external resistance for the .72A tap is 112.5 ohms; .36A tap is 450 ohms and for the .18A tap 1800 ohms.

2.1.3 Regulation: In the voltage mode, the regulation can be adjusted by first observing the output voltage under no load and then adjusting the Reg. Adj. for the same output voltage under a loaded condition. On the current mode, the regulation can be adjusted by first observing the current with maximum rated or less external resistance and adjusting the Reg. Adj. control for the same current into a short circuit.

2.1.4 Output Connections: A pair of general purpose output leads are furnished with each SF-613-1 system for connecting the load to the power unit, one black 5,000 volt insulated No. 12 wire lead with insulated high current spade lug on one end and a 25 amp "Supercon" receptacle on the other end for connection to the common plug on the front panel, and one red 5,000 Volt insulated No. 12 wire lead with insulated high current spade lug on one end and a 25 amp "Supercon" plug on the other end for connection to the desired output receptacle on the front panel. In the event that these leads are not compatible to a specific application, the "Supercon" connectors can be removed from the general purpose output leads and used with suitable leads. CAUTION: Be sure any leads used on high voltage have adequate insulation for any high voltages. Also be sure that wire size is heavy enough on high current (No. 12 or heavier for 18 amps).

2.2 Installation

2.2.1 Mounting: The 613 Amplifier may be mounted in a standard Retma 19" rack panel or may be used as a bench instrument.

2.2.2 Line Power: This unit requires 105 to 125V, 60 Hz.

2.2.3 Input Signal: A BNC connector is provided on the rear chassis for variable signal input from the SF 613-1 exciter unit.

2.2.4 Output: The output of the power unit is available at seven receptacles located on the front panel, using the black common plug for all seven outputs.

2.2.5 Grounding: The low side of the instrument output is common to system and chassis ground.

SECTION 3 THEORY OF OPERATION

3.0 Introduction: The SF 613-1 Power Unit accepts a signal from the Exciter Unit, and produces a constant current or constant voltage output, depending on the operating mode selected. Seven outputs on the front panel provide a wide range of output voltages and currents.

3.1 Amplifier: The heart of the Power Unit is a wideband 200 watt power amplifier. This power amplifier uses solid-state direct coupled operational amplifiers in the "front end", with a conventional push-pull pentode output stage. Figure 3.1 is a simplified schematic of this amplifier. Referring to Figure 3.1, $A_1$ and $A_2$ are operational amplifiers. Since the output stage operates in push-pull, the signal voltage at the control grids of $V_a$ and $V_b$ should be equal in amplitude and opposite in phase. This is accomplished by $A_1$, which operates as a unity gain inverting amplifier. The signal input to $A_1$ is the output of $A_2$. Thus, the signals at the control grids of $V_a$ and $V_b$ are out of phase. The control grids are direct coupled to the outputs of the operational amplifiers. The bias level on the control grids is determined by the setting of the BIAS ADJ potentiometers and the ratio of the bias input resistor (10 Meg ohms) to the operational amplifier feedback resistance (about 600K ohms). Negative feedback is taken from the secondary and tertiary windings of the transformer. Above 50KHz, negative feedback is taken from the tertiary (7-8) winding. Below 50KHz, feedback is taken from terminal 6 of the secondary (5-6) winding. The gain of the $A_2$ operational amplifier is shaped by its local feedback loop (the R-C network just above $A_2$ in Figure 3.1) so that the gain is very high at midband (50Hz - 10KHz) frequencies, resulting in a large amount of negative feedback around the amplifier. This contributes to the stability and low distortion level of the amplifier.

3.2 Operational Amplifiers: Figure 3.2 is a simplified schematic of operational amplifier $A_1$ or $A_2$. $Q_a$ is a field effect transistor, while $Q_b$ is a bipolar transistor with a very high collector breakdown voltage.

Vacuum tube $V_a$ is a frame-grid dual triode with the two sections wired in parallel, and is used as a cathode follower. $Q_b$ is a grounded base amplifier, with $Q_a$ - $Q_b$ forming a semiconductor version of the old "cascode" circuit. Positive feedback is used to increase the gain of the circuit inside the loop while negative feedback is taken around the loop to stabilize the amplifier at the desired gain (unity in the case of $A_1$, a complex "shaped" gain in the case of $A_2$) and to establish the proper DC bias for the output tubes. The maximum positive swing into the grids of the output tubes should ideally be limited so that the grid signal cannot go positive. This result is aproximated in the following manner: since the base of $Q_b$ is biased at -3.8V, the collector cannot go more positive than this value. Since this collector is tied to the control grid of $V_a$, the control grid cannot go more positive than -3.8V. The nominal operating point of $V_a$ is such that the grid-cathode bias is about -3.8 volts. Thus the maximum positive swing at the cathode of $V_a$ is limited to about 0V. In the standby mode, the bias on the base of $Q_b$ is increased to about -9.6V, further limiting the maximum positive swing of $V_a$. See Par. 3.9.

3.3 Output Stage: The power amplifier output stage is mounted on a swivelled air duct. The Rotron fan, B401, removes the considerable heat generated by the eight output tubes. Refer to schematic 10-716. The output tubes are Sylvania 8417's, specially aged and matched in sets of eight, bearing the NHR part number 15-041. Since these tubes have a very high transconductance, parasitic suppression networks are used. Each screen grid has a 39 ohm resistor mounted directly on the tube socket, with a 1200pf disc ceramic capacitor shunting the other side of each of these resistors to ground. Each plate has a 15 ohm resistor, and the plate circuits are bypassed with series-connected capacitors C403, C404 and C408, C409. 100 ohm parasitic suppressors are mounted in series with each control grid. Each cathode uses a 1 ohm series current sampling resistor. The voltage at each cathode will be 50Mv if each tube is drawing 50Ma total plate and screen current, the nominal value. The cathode voltages of V401-4 are summed together and brought out to $TP_1$. Similarly, the cathode voltages of V405-8 are summed and brought out to $TP_2$. After an

adequate warmup (15-30 minutes), the voltage at these test points should be 50Mv. The appropriate bias potentiometer for adjusting the quiescent tube current is located directly below each test point.

3.4 Voltage Mode: In the voltage mode, the Power Unit provides an output voltage which is substantially independent of loading conditions over most of the frequency range of the instrument. Refer to Figure 3.3. $R_b$ is a 1/4 ohm (formed by four one-ohm resistors connected in parallel) current sensing resistor. $R_c$, the regulation adjustment, is connected across $R_b$. The current feedback taken from this potentiometer is used to compensate for the load lag. It is possible to adjust the regulation to zero from 10Hz to over 10KHz. Decreasing feedback at high frequencies, plus limitations in transformers T2, 3 and 4, prevent the regulation adjustment from being effective at the highest frequencies. K202 is closed in this mode, so that the effective input resistance is the parallel value of R201 and R202, or 10K ohms. The (low frequency) feedback from the T2 secondary returns through about 800K ohms, so that the nominal sensitivity of the amplifier is 2V RMS input for 160V RMS output, which corresponds to full scale meter deflection.

3.5 Current Mode: In the current mode, the power unit will provide an output current which is substantially independent of loading conditions over the middle of the frequency range. In this mode, voltage feedback is used to adjust the load regulation. In the current mode, a short-circuit across the output corresponds to a no-load condition. Refer to Figure 3.4. The low frequency feedback signal is taken from $R_a$, (two high-power 72 ohm resistors connected in parallel), a 36 ohm resistor. Note that terminals 5 and 6 have been reversed, and that the output is taken from Terminal 5. SW-4, K1 and K2 are used to switch from voltage to current mode. Note that $R_a$ is used as part of an RLC circuit in the voltage mode, in Range II only (see Par. 3.5). Since the gain is effectively increased by a factor of two in the current mode, excitation is removed from K202, thus opening the input signal path through C202 and R202, returning the gain to its normal value.

3.6 Load Match Transformers: T3 and T4 are autotransformers used to step the voltage or current output up or down. A range switch is used so that only one of these two transformers will be in use at one time. This switch also serves to disable the high-voltage outputs J5, 6, and 7 when they are not in use. Refer again to Figure 3.3. In Range II, the high voltage range, the voltage metering is taken directly off J7, the highest voltage output tap, through $R_d$. $R_d$ is actually a compensated divider using nine resistors, R601-9, and six capacitors, C601-6 (see schematic 10-718 for details). T3, the high voltage transformer, becomes resonant at the highest output frequencies (50-100 KHz). $R_a$, $L_a$ and $C_a$ in Figure 3.3 (L1, C4, R2 and R3 on schematic 10-718) are used to compensate for this resonant effect.

3.7 Power Supply: The power supply operates from 115V ±10V, 60Hz line power. Filament power for the various vacuum tubes is taken from the three 6.3V windings on T1 (see schematic 10-696). The outputs of two full-wave capacitor-input bridge rectifiers (CR 1-8) are connected in series to provide +600V for the plates of the output tubes. A 2A fuse, F2, is connected between these rectifiers for power supply protection in the event of a shorted output tube. The output of the lower bridge rectifier (CR 5-8) is used as the unregulated source of the +250V regulated supply.

3.7.1 +250V Regulator: Q1 and Q105-9 form the +250V regulator. CR108, a 7.5V zener diode, is the regulator reference. Q105 and Q109 form a differential amplifier. The outputs of these transistors are connected to Q106 and Q108, a second differential amplifier. The output of Q106 is connected to the input of Q1, the high-voltage pass transistor. CR107 regulates the voltage across R113, so that a constant current flows toward the junction of the Q1 base and the Q106 collector. R115 and Q107 combine to limit the current in Q1. When the voltage across R115 approaches 600Mv, Q107 will turn on, limiting the base current available for Q1, and thus limiting the current. The +250V supply is factory adjusted to the correct output voltage by selecting R112.

3.7.2 Screen Supply: The screen grids of the eight output tubes use semi-regulated +250V. This is taken from Q2, the pass element for this supply. The base of Q2 is connected directly to the regulated +250V, so that the output of the screen supply will normally be about +249V. F3 protects the pass element, Q2, from excessive screen current.

3.7.3 -150V Supply: A full wave capacitor input bridge rectifier (CR 101-4) provides the unregulated power for the -150V supply. This supply is referenced to the +250V regulated supply through R105 and R106. C103 filters any ripple or noise that may be present on the +250V supply. Q102 and Q104 form a differential amplifier, with the output of Q102 controlling Q101, the pass element. The current through R103 is sensed by Q103. When the voltage across this resistor begins to exceed about 500Mv, Q103 will start to conduct, limiting the current in Q101.

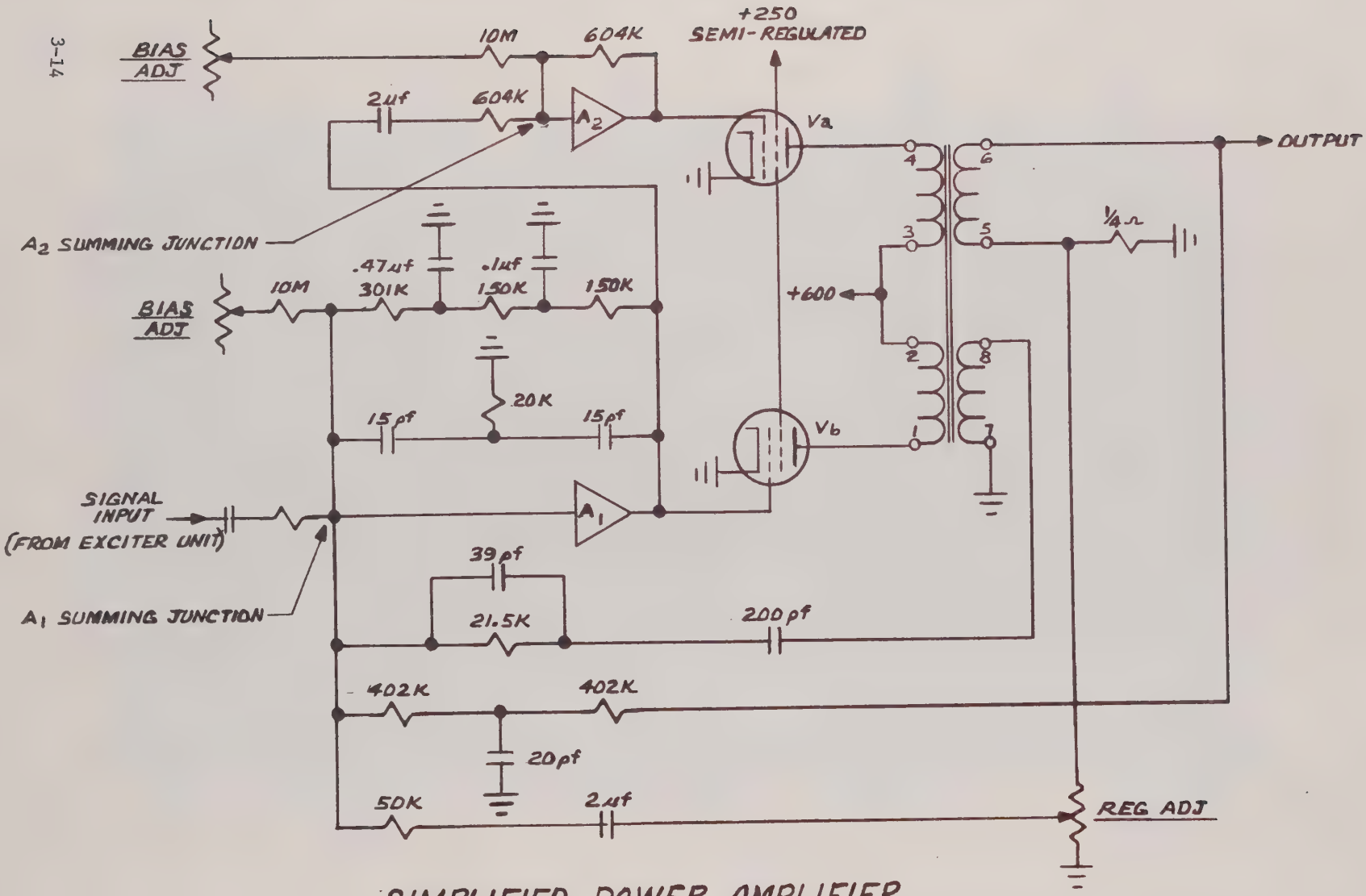
3.7.4 -12.5V Supply: The -12.5V supply is referenced to the +250V supply through R127 and R128. C108 filters any ripple or noise that may be on the +250V supply. Q110 and Q111 form a differential amplifier, with the output of Q111 controlling the pass element, Q112. R124 limits the current and dissipation in Q112 to safe levels. R125 provides a shunt path for current around Q112.

3.7.5 -25V Supply: This unregulated supply provides power for K501 and I2. See schematic 10-717.

3.8 Metering Circuit: Refer to schematic 10-704. R301 is the voltage calibration potentiometer, while R302 is the current calibration potentiometer. The wiper of each potentiometer is brought out to SW3, the meter selection switch. The wiper of the switch is returned to the meter amplifier, formed by Q309, Q310, Q311, and Q312. The sensitivity of this amplifier is about 450 millivolts AC for a full scale deflection of M1, the front panel meter. The exact sensitivity is adjusted by selecting R342. This circuit is an operational rectifier, where the AC feedback signal from the collector of Q311 must pass through the bridge rectifier, CR 305-308. C305 and R343 provide filtering action to minimize meter flutter at 10Hz.

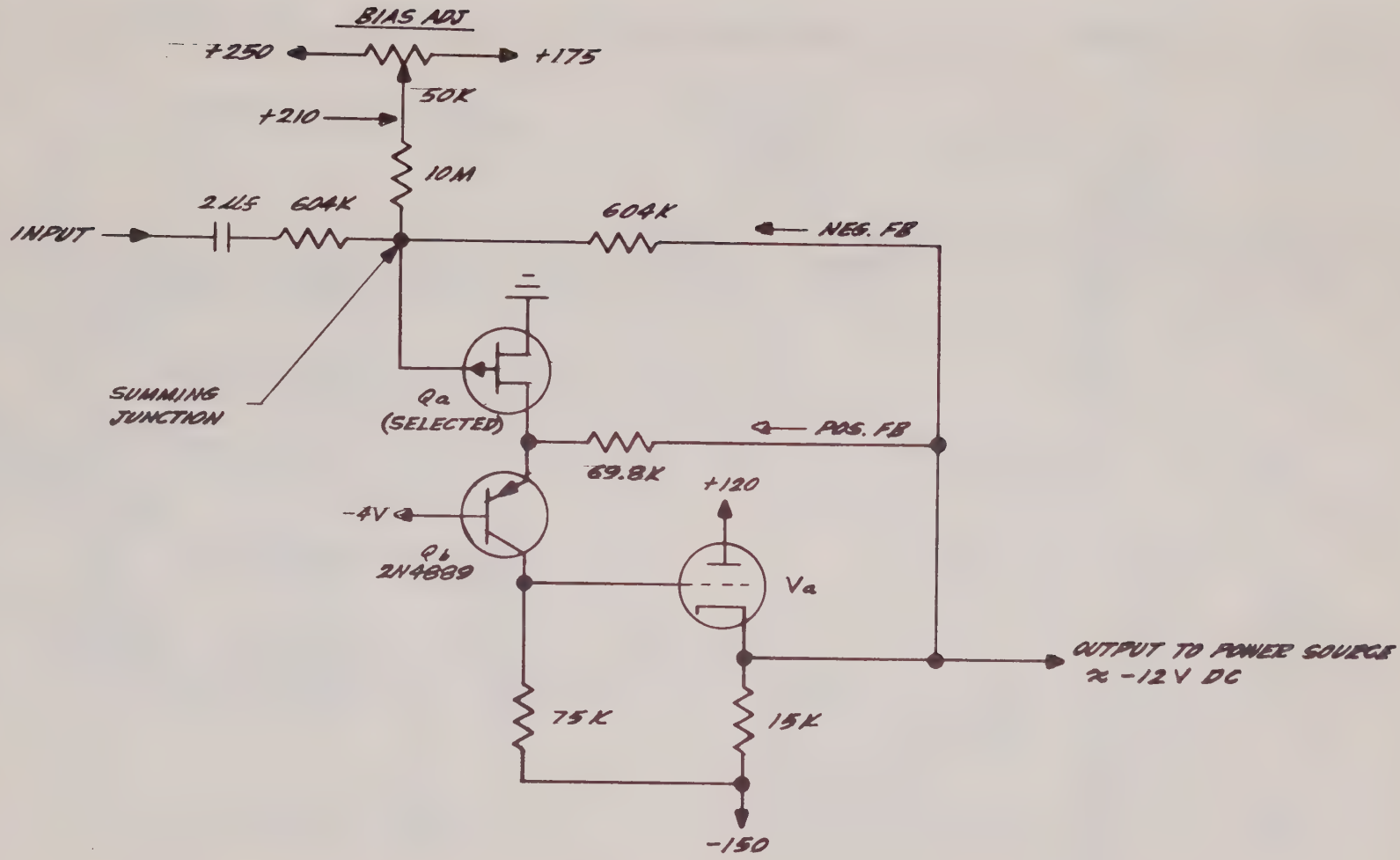
R340 provides a DC feedback path, stabilizing the DC operating point at the collector of Q311.

3.9 Standby/Overload Circuit: The standby and the overload circuit are one and the same; the standby switch is merely a manual trip for the overload circuit. Standby is accomplished by a) removing excitation from K201, thus disconnecting the input signal, b) applying excitation to K501, thus shorting the wiper of the regulation adjustment to ground, c) turning on Q501, thus increasing the negative bias on the bases of Q202 and Q204 (see par. 3.2), and d) lighting I2 to indicate that the instrument has been transferred to the standby/overload mode of operation. If the standby/overload mode is initiated by an overload condition, Q302 and Q303, a bistable pair, provide an indefinite "memory" of the overload condition, even though SW2 may be in the on/reset position. Q302 and Q303 may be returned to the operating mode by moving SW2 to the standby position, and then returning it to the on/reset position. In the normal operating mode, Q303 is off, and Q302 is on. This may be accomplished by placing SW2 in the standby position, so that Q303 is turned on by current through R327 and R328. Or, in the event of an overload, Q303 may be turned on by current from Q306 or Q307. The differential pair Q305 and Q306 detect excessive output current, while Q307 and Q308 detect excessive output voltage. This detection process may be described as follows: when there is no output voltage or current, there is no voltage, either AC or DC, present at the wipers of R301 and R302. Thus the bases of Q305 and Q308 are more positive than the bases of Q306 and Q307, so that all of the current through R315 and R320 is conducted by Q305 and Q308. When the AC voltage on the wiper of R301 or R302 increases, corresponding to increasing output voltage or current, the negative peak of this AC signal will eventually be more negative than the bias applied to the bases of Q306 or Q307 will conduct, turning on Q303, initiating actions a) through d) mentioned previously. The bias on Q306 and Q307 is set so that the trip point is about 5-15% above the rated maximum voltage or current. Note that the current and voltage trips are completely independent, and that both are fully operative regardless of the mode of operation.



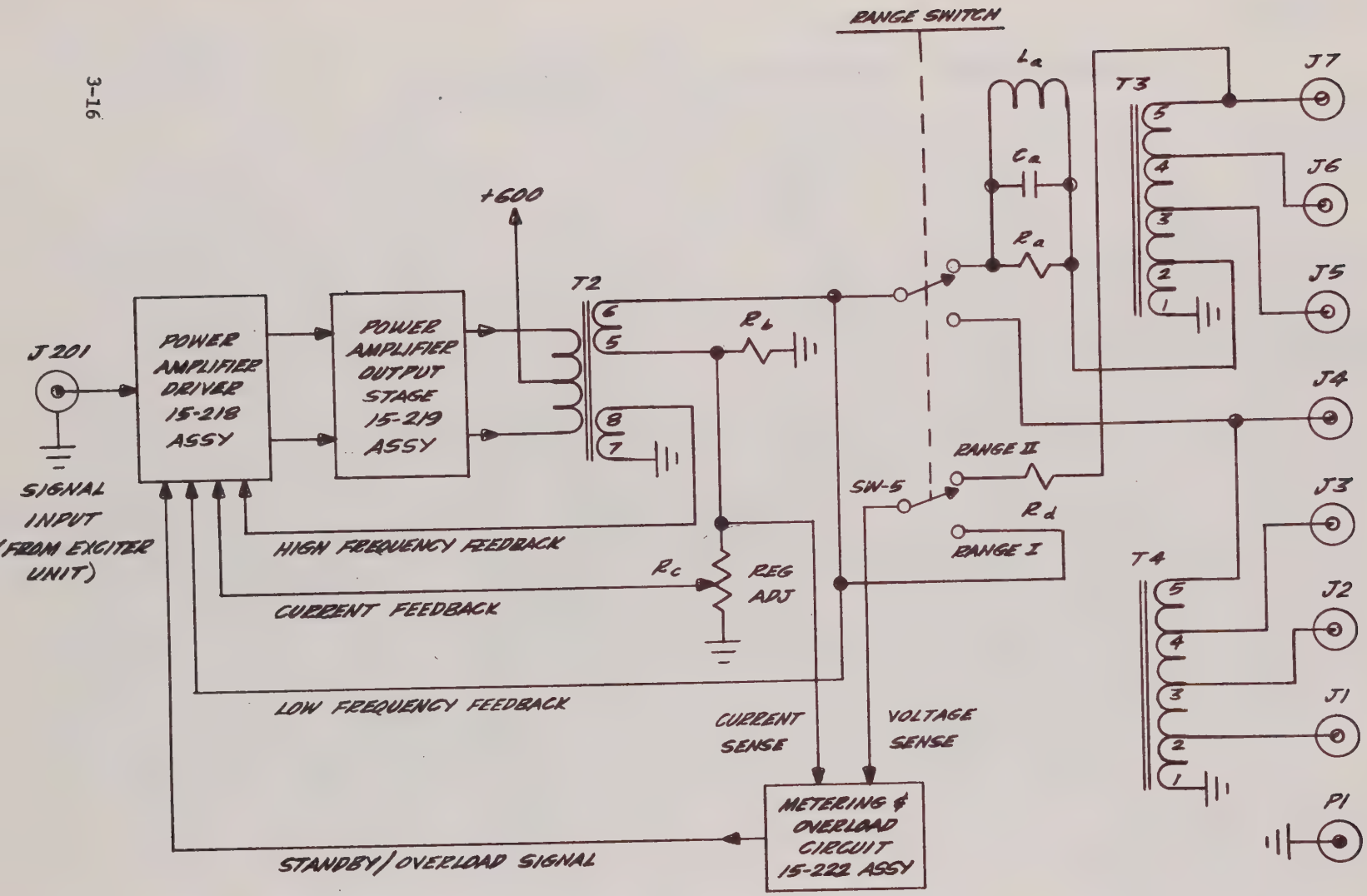

SIMPLIFIED POWER AMPLIFIER

FIG 3.1



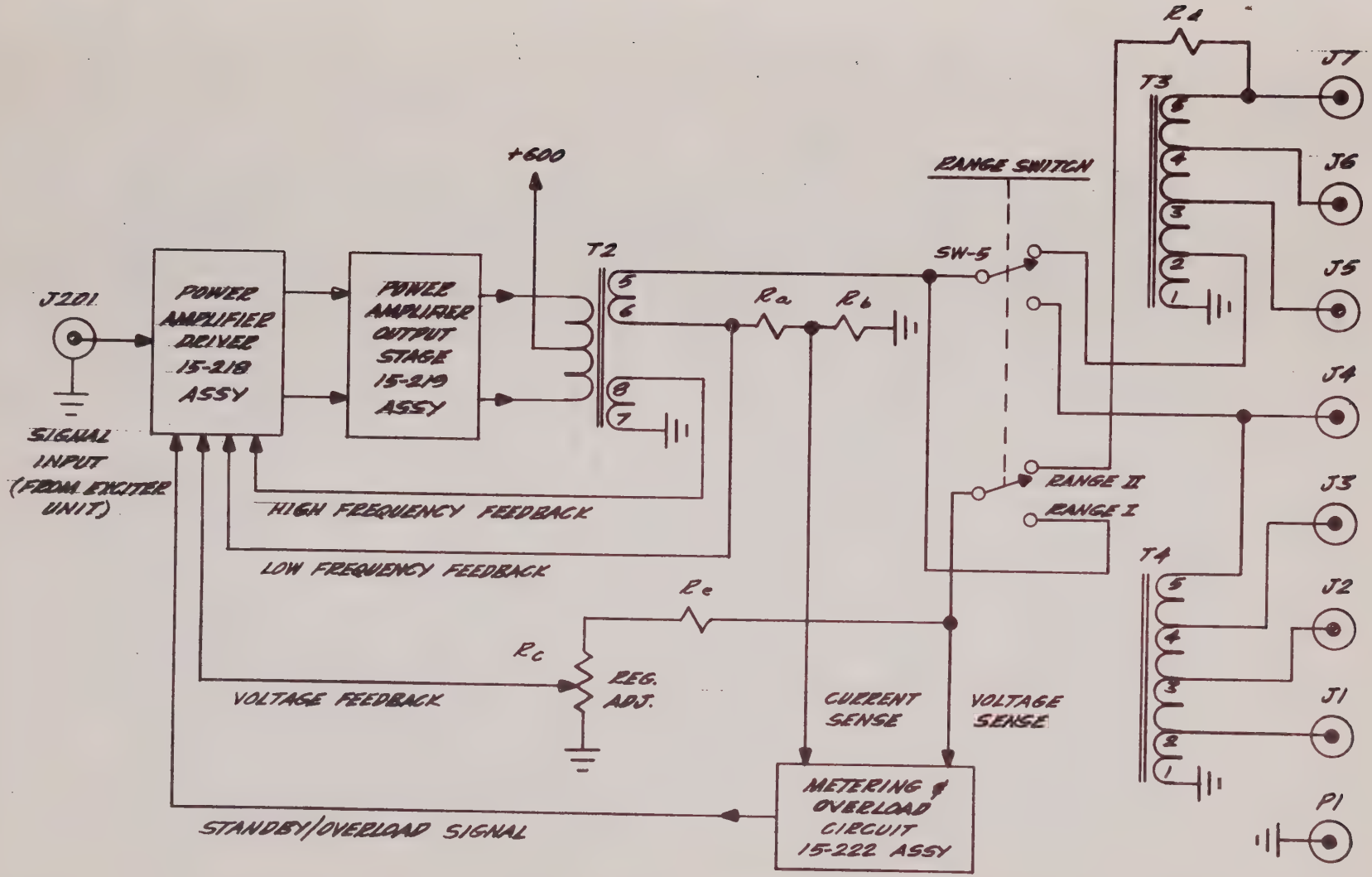

TYPICAL OPERATIONAL AMPLIFIER

FIG. 3.2




POWER UNIT SIMPLIFIED BLOCK DIAGRAM (VOLTAGE MODE)

FIG. 3.3




POWER UNIT SIMPLIFIED BLOCK DIAGRAM (CURRENT MODE)

FIG. 3.4

SECTION 4 MAINTENANCE

4.0 In the event of apparent malfunction of the power unit, the first step is to isolate the problem to one of the subassemblies. Since the amplifier portion of the power unit is the only section which uses vacuum tubes, it can be expected that most failures will occur in this area.

4.1 Amplifier: A simple test to determine if the amplifier is working properly is to measure the cathode current in the output tubes, at the test points on the left hand side. With the On/Reset-Standby switch placed in the standby position, the cathode current will normally be about 40 ma a couple of minutes after turn-on, increasing to 50 ma after a twenty or thirty minute warmup. The voltage at the test point is 1 ma = 1 mv, or 50 mv normal bias level after a suitable warmup. If a sensitive, high impedance voltmeter is not available, the 50μA range of a 20,000 ohm/Volt VOM such as a Simpson Model 260 may be used. Assuming a meter movement resistance of 5000 ohms, the 50 mv signal will produce a 10μA reading. If no current is evident at either test point, the plate and screen fuses, F2 and F3, should be suspect. If the current is normal at one test point but zero at another test point, either one of the operational amplifiers on the 14-125C board is defective, or all of the plate or screen resistors on one side of the output stage may be open (damaged). The voltage at TP1 checks the cathode current of V401-4, while the voltage at TP2 checks the cathode current of V405-8 [NOTE: if the cathode currents are merely slightly off, say 25 - 65 ma, this is not normally evidence of failure, but rather of a need for bias readjustment. See Par. 5.0].

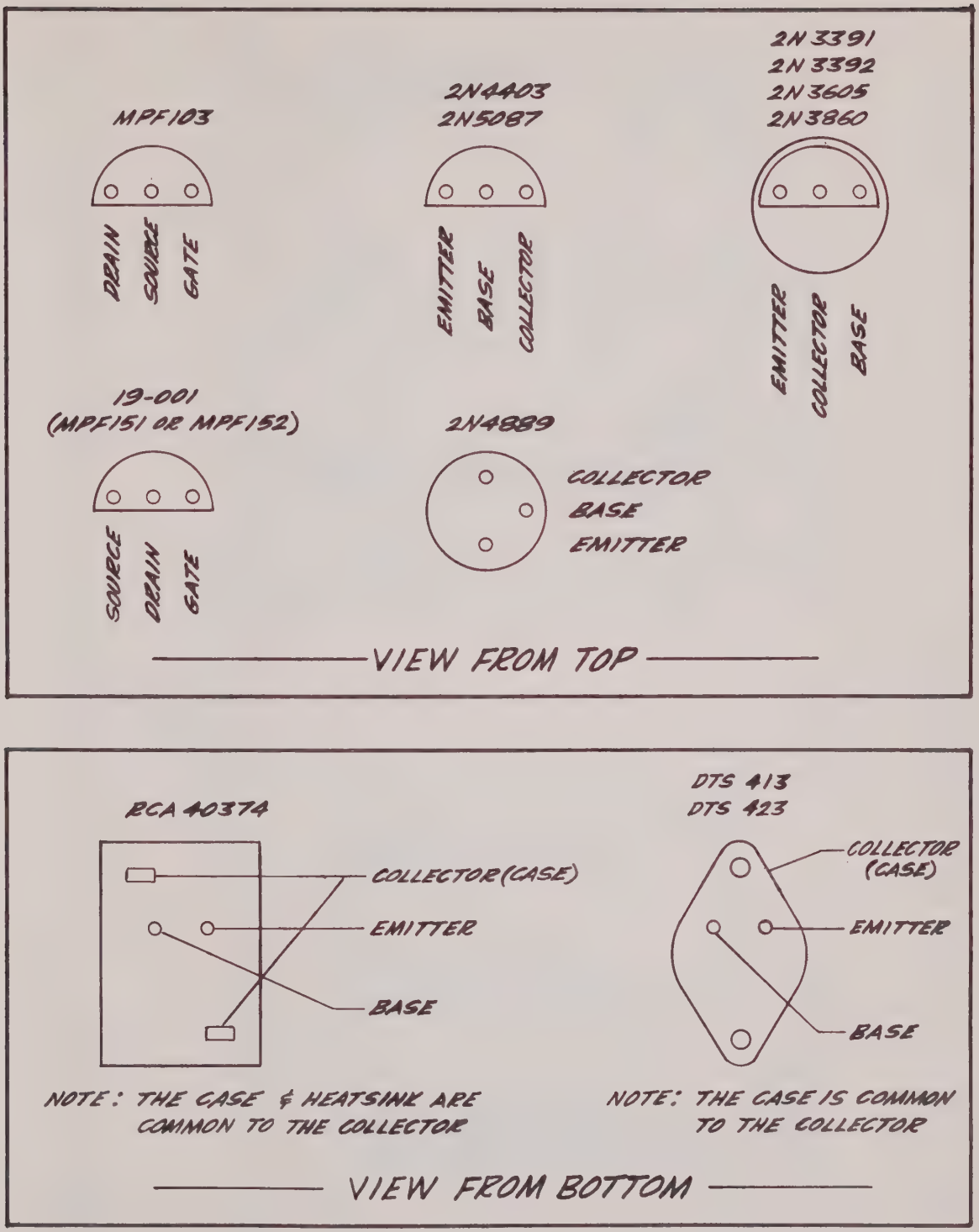
4.1.1 Assuming that the bias measurements indicate an amplifier malfunction, the next step is to remove the top cover of the power unit. The plate and screen fuses, F2 and F3, are mounted on the flange on the rear chassis plate. If one of these fuses is open, the air duct should be tilted up and the plate resistors (15 ohms) and screen resistors (39 ohms) inspected.

An open (damaged) resistor is evidence of a defective tube. If several resistors are open (on more than one tube socket), the operational amplifier driving those output tubes may have failed.

4.1.2 If a defect in the power amplifier drivers is suspected, the eight output tubes should be removed from the air duct. The position of each tube should be noted so that the tubes may be replaced in the same sockets. V401-4 are the four tubes furthest from the fan on the air duct, while V405-8 are the four tubes closest to the fan. Referring to Figure 3.1 in Section 3, $A_2$ is the operational amplifier with the shaped local feedback network (see Par. 3.2). When the output tubes are removed, this operational amplifier should oscillate, since the negative feedback around the output transformer $T_2$ is lost. The presence of this oscillation is evidence that $A_2$ is functioning normally. Referring to schematic 10-717, transistors Q203, 204 and 205, with tube V202, comprise $A_2$. The oscillation may be conveniently measured by using an oscilloscope on pin 5 of the V401 socket, the socket furthest from the fan. If $A_2$ is defective, a constant DC level will be observed, either about -1VDC (say -3V to +1V) or about -135VDC. The condition of $A_1$ may be checked by the oscilloscope at pin 5 of the V408 socket, the one closest to the fan. If $A_2$ is oscillating, this signal will be fed into $A_1$ so that the output of $A_1$ (a unity gain amplifier) should have the same signal present, if it is operating normally. If $A_2$ is defective, the output of $A_1$ will be a steady DC level, about -12VDC. If $A_1$ is defective, the output of $A_2$ will probably be a constant DC level, either -3V to +1V, or about -135V.

4.2 Power Supply: The 14-124 circuit board, mounted on the rear panel, contains the circuitry for the three regulated power supplies (+250, -150, -12.5). Test points are provided on this board for checking these supplies. The +250V supply is independent of the other supplies and should be checked first. The -150V supply is dependent only on the operation of the +250V supply, and should be checked second. The -12.5 supply is dependent on both the +250V supply and the -150V supply, and should be checked last.

4.3 Overload and Metering Circuit: These circuits are fully transistorized and operate at very low power levels, hence minimum maintenance difficulties should be experienced in this section. If troubles are suspected in this area, the amplifier and power supply should be double checked, and I2, the incandescent lamp, should be checked. With power removed from the unit, the cold resistance of I2 will run about 160 ohms. Table 4-1 lists typical voltages in both the standby and the on (operate) modes as an aid to further troubleshooting.




## TRANSISTOR TERMINAL ORIENTATION

## SF 613-1 POWER UNIT

FIG 4-1

NOTE: The following DC voltage measurements are typical values. Some variation should be expected from instrument to instrument. Measurements should be made with a high impedance meter such as a VTVM. A 20,000 ohm/volt VDM is not satisfactory for this purpose.

DRIVER AMPLIFIER
(see schematic 10-717)

| Location | | Standby | On/Stdby |
|---|---|---|---|
| Q201 | Gate | +0.8 | +0.75 |
| Q201 | Drain | -9.1 | -3.3 |
| Q202 | Base | -9.6 | -3.8 |
| Q202 | Collector | -15.5 | -15.9 |
| V201 | Cathodes | -11.3 | -11.5 |
| V201 | Plates | +132 | +133 |
| Q203 | Gate | +0.8 | +0.75 |
| Q203 | Drain | -9.1 | -3.3 |
| Q204 | Base | -9.6 | -3.8 |
| Q204 | Collector | -15.5 | -15.9 |
| V202 | Cathodes | -11.3 | -11.5 |
| Q501 | Collector | -12.4 | -5.2 |
| Q501 | Base | -11.9 | -13.1 |
| I2-R502 | Junction | -5.4 | -24.6 |

METERING & OVERLOAD CIRCUIT
(see schematic 10-704)

| Location | | Standby | On/Stdby |
|---|---|---|---|
| Q301 | Collector | -0.1 | -24.6 |
| Q302 | Collector | -2.5 | -0.06 |
| Q303 | Collector | -0.03 | -4.1 |
| Q303 | Base | -0.75 | -0.03 |
| SW2 | Wiper | -4.4 | 0.0 |
| Q304 | Collector | -24.4 | -0.04 |
| Q305 | Collector | +1.05 | Same |
| Q305 | Base | 0.0 | Same |
| Q306 | Base | -0.65 | Same |
| Q307 | Base | -0.6 | Same |
| Q308 | Base | 0.0 | Same |
| Q309 | Gate | -3.2 | Same |
| Q310 | Gate | -4.2 | Same |
| Q311 | Base | -0.55 | Same |
| Q311 | Collector | -4.2 | Same |
| Q312 | Base | -8.1 | Same |
| Q312 | Emitter | -8.6 | Same |

TABLE 4-1

SF 613-1 POWER UNIT

NOTE: Measurements made at 115V line. These measurements should be made with a high impedance voltmeter such as a VTVM. A 20,000 ohm/volt VDM is not satisfactory for for this purpose.

## POWER SUPPLY
(see schematic 10-696)

+250V REGULATOR

| Location | | Standby | On/Stdby |
|---|---|---|---|
| Q1 | Collector | +312 | Same |
| Q1 | Emitter | +250.4 | Same |
| Q1 | Base | +251 | Same |
| R113-CR107 | Junction | +257.5 | Same |
| Q105 | Base | +242.5 | Same |
| Q105 | Emitter | +242.0 | Same |
| Q105 | Collector | +247.0 | Same |
| Q106 | Emitter | +246.5 | Same |
| Q109 | Base | +242.5 | Same |
| Q109 | Collector | +247.0 | Same |

-150V REGULATOR

| Location | | Standby | On/Stdby |
|---|---|---|---|
| Q101 | Emitter | +0.35 | Same |
| Q101 | Base | +0.90 | Same |
| Q101 | Collector | +48 | Same |
| Q104 | Base | 0.0 | Same |
| Q104 | Emitter | -0.55 | Same |

-12.5V REGULATOR

| Location | | Standby | On/Stdby |
|---|---|---|---|
| Q111 | Emitter | +0.55 | Same |
| Q111 | Base | 0.0 | Same |
| Q111 | Collector | -12.0 | Same |
| Q112 | Collector | -19.6 | -19.8 |

TABLE 4-1

SF 613-1 POWER UNIT

5.0 General: Because of the precision components and large amounts of both AC and DC feedback used in the power unit circuitry, only a few minor adjustments are necessary at approximately a 30 day interval to insure proper operation. Since this instrument is basically only a power supply, none of these adjustments require that any precision measurements be made in order to perform the calibration.

5.1 Bias Adjustment: A minimum of 30 minutes warm-up is recommended before making bias adjustments. With standby switch in standby position, adjust R201, located on the left side panel, while monitoring TP1 for .05 Vdc, using TP3 as a ground return. Likewise, adjust R202 for .05 Vdc at TP2. If a sensitive, high impedance voltmeter is not available, the 50μA range of a 20,000 ohm/volt VOM such as a Simpson Model 260 may be used. Assuming a meter movement resistance of 5000 ohms, the .05V (or 50 millivolt) signal will produce a 10μA reading. CAUTION: Counter-clockwise position of R201 and 202 is minimum bias and will cause excessive tube current. When unsure of setting, try the midway position and set R201 and 202 to approximate values promptly after turning power on, then wait for a normal warm-up and re-adjust.

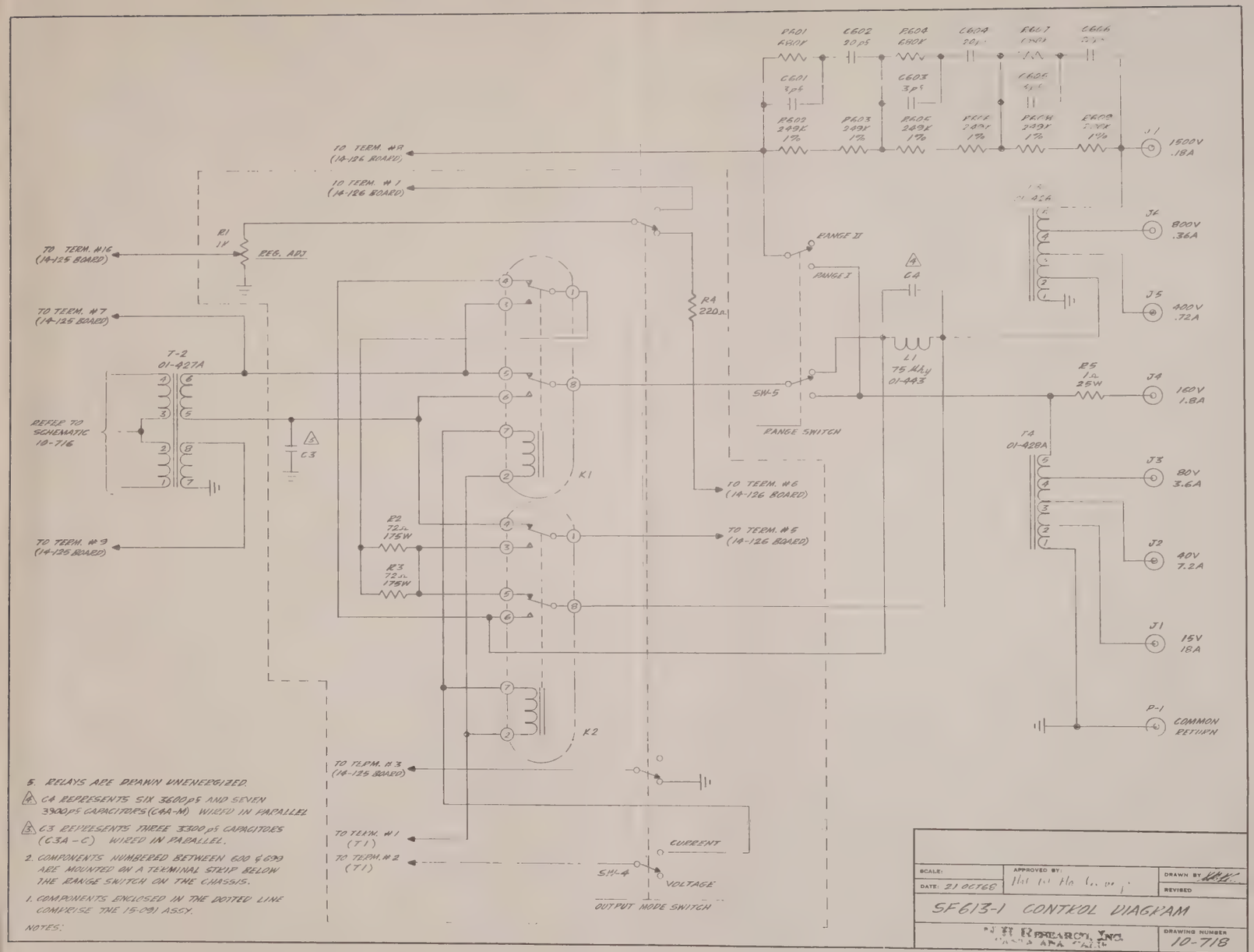
5.2 Metering Adjustments: In the voltage mode, read the output voltage at 120V on the 160V tap, 1 KHz, with a suitable secondary or working standard and adjust R301 on the right side panel for a reading of 120V on the front panel meter. In the current mode read the output current at 1.2 amps on the 1.8A tap with a suitable secondary or working standard and adjust R302 for a reading of 1.2 amps on the front panel meter.

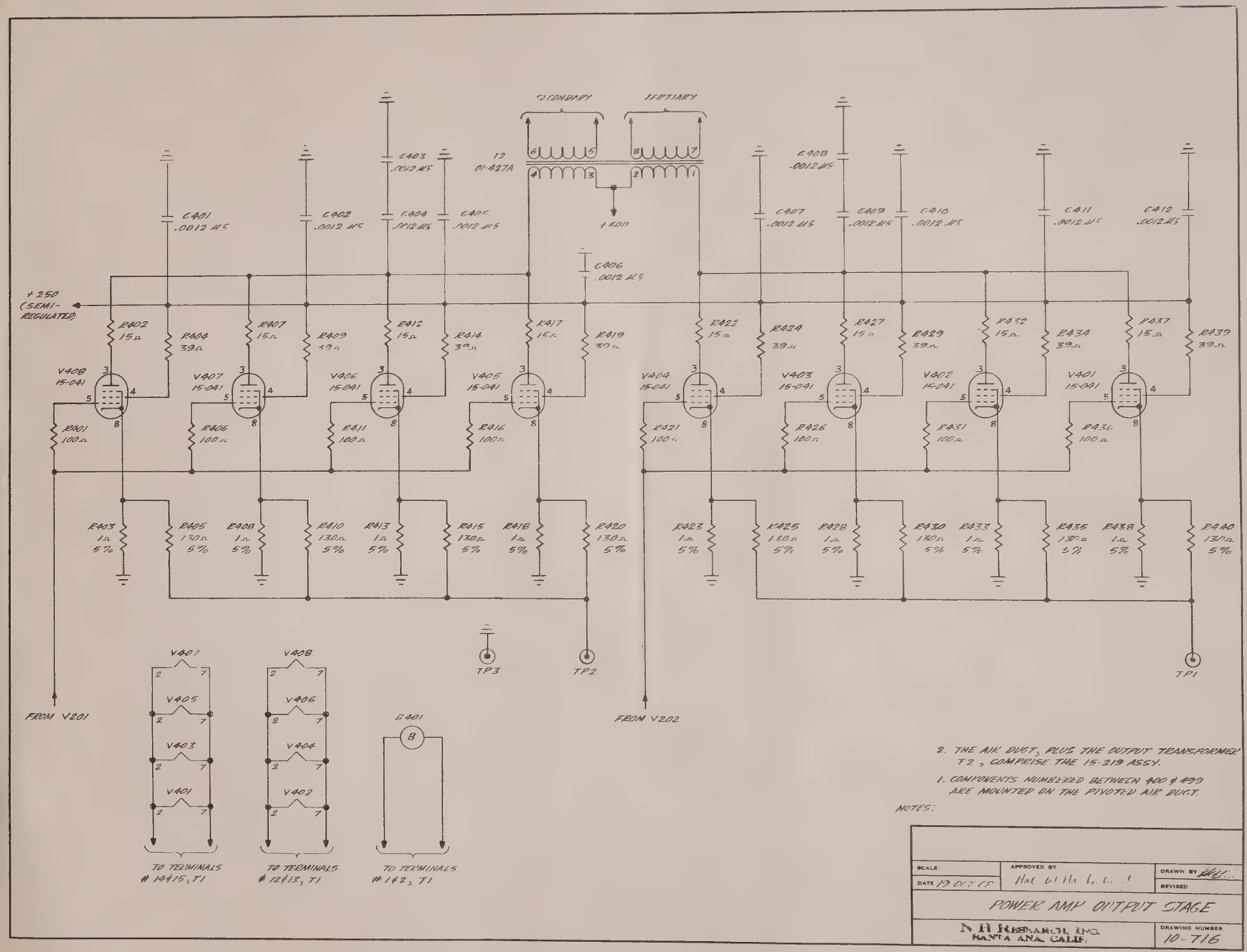
5.3 C207 Adjustment: This capacitor does not normally require frequent readjustment. If the 100KHz distortion is above 1% after warmup, and the bias has been adjusted in accordance with Par. 5.1, the top cover may be removed and C207 adjusted for minimum distortion. C207 is located on the top left side of the 14-125C board. The normal position of the adjustment is 50% to 65% closed. If the distortion is within specifications, it is recommended that this setting not be disturbed.

[1] This procedure is to be used only in maintenance. For calibration procedure, see TB 750-236.

# SECTION 6

# SCHEMATICS


R601 249K 1%
C602 30 pf
R604 249K 1%
C604 30 pf
R607 249K 1%
C606 30 pf
C601 3 pf
C603 3 pf
C605 4 pf
R602 249K 1%
R603 249K 1%
R605 249K 1%
R606 249K 1%
R608 249K 1%
R609 249K 1%
J1 1500V .18A
J2 40V 7.2A
J3 80V 3.6A
J4 160V 1.8A
J5 400V .72A
J1 15V 18A
P-1 COMMON RETURN
TO TERM. #9 (14-126 BOARD)
TO TERM. #1 (14-126 BOARD)
TO TERM. #16 (14-125 BOARD)
TO TERM. #7 (14-125 BOARD)
TO TERM. #3 (14-125 BOARD)
R1 1K REG. ADJ
T-2 01-427A
REFER TO SCHEMATIC 10-716
C3
R2 72Ω 175W
R3 72Ω 175W
K1
K2
R4 220Ω
RANGE II
RANGE I
C4
L1 75 MHy 01-443
SW-5
RANGE SWITCH
R5 1Ω 25W
T4 01-428A
TO TERM. #6 (14-126 BOARD)
TO TERM. #5 (14-126 BOARD)
TO TERM. #3 (14-125 BOARD)
TO TERM. #1 (T1)
TO TERM. #2 (T1)
SW-4
CURRENT
VOLTAGE
OUTPUT MODE SWITCH
5. RELAYS ARE DRAWN UNENERGIZED.
4 C4 REPRESENTS SIX 3600 pf AND SEVEN 3900 pf CAPACITORS (C4A-M) WIRED IN PARALLEL
3 C3 REPRESENTS THREE 3300 pf CAPACITORS (C3A-C) WIRED IN PARALLEL.
2. COMPONENTS NUMBERED BETWEEN 600 & 699 ARE MOUNTED ON A TERMINAL STRIP BELOW THE RANGE SWITCH ON THE CHASSIS.
1. COMPONENTS ENCLOSED IN THE DOTTED LINE COMPRISE THE 15-091 ASSY.
NOTES:
SCALE:
DATE: 21 OCT 66
APPROVED BY:
DRAWN BY
REVISED
SF613-1 CONTROL DIAGRAM
DRAWING NUMBER 10-718




2. THE AIR DUCT, PLUS THE OUTPUT TRANSFORMER T2, COMPRISE THE 15-219 ASSY.

1. COMPONENTS NUMBERED BETWEEN 400 & 499 ARE MOUNTED ON THE PIVOTED AIR DUCT.

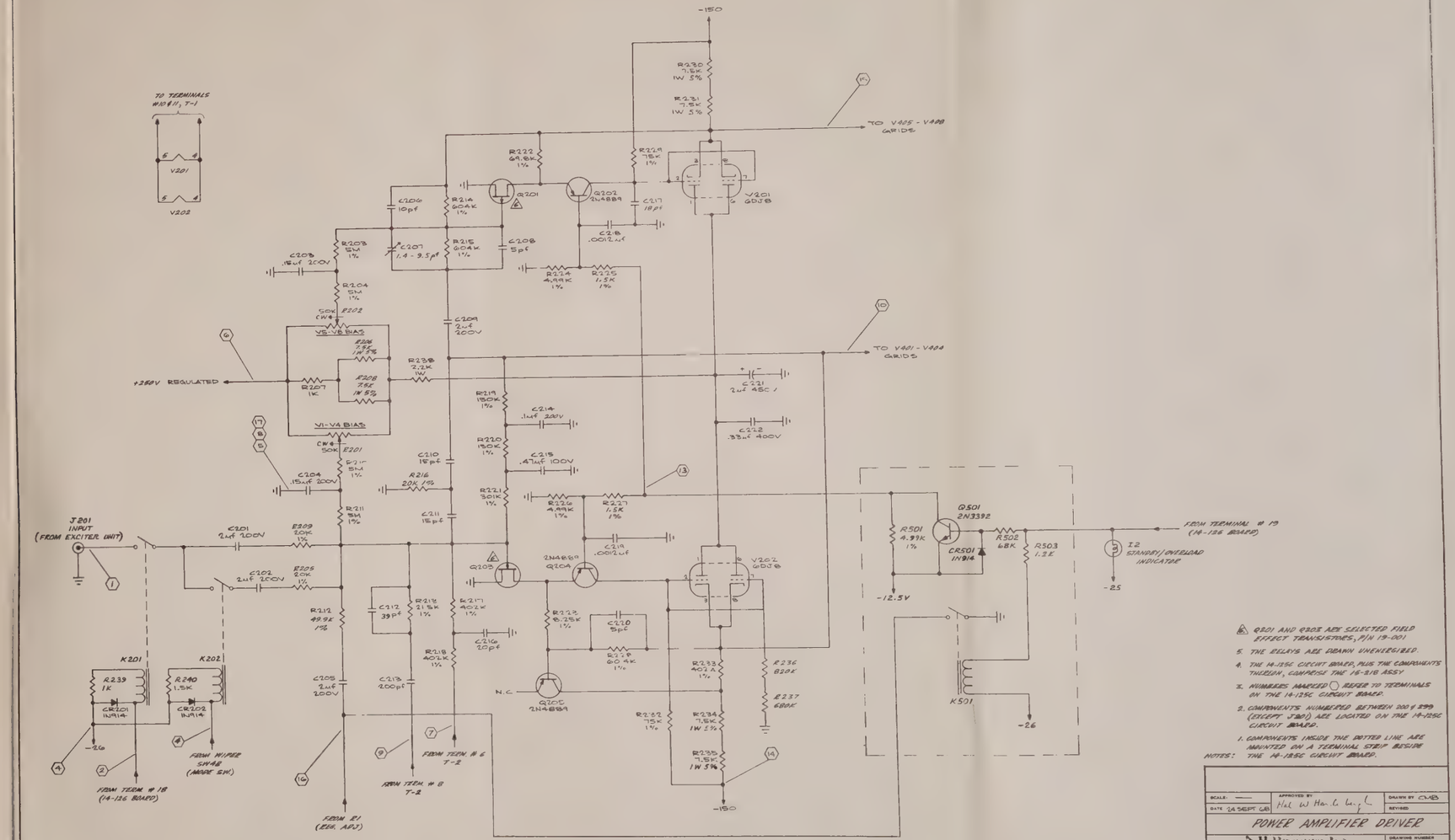
NOTES:

| | | |
|---|---|---|
| SCALE | APPROVED BY Hal Wills | DRAWN BY |
| DATE 13 OCT 65 | | REVISED |

POWER AMP OUTPUT STAGE

H H SCOTT INC. SANTA ANA, CALIF.

DRAWING NUMBER 10-716




⚠ Q201 AND Q203 ARE SELECTED FIELD EFFECT TRANSISTORS, P/N 19-001

5. THE RELAYS ARE DRAWN UNENERGIZED.

4. THE 14-125C CIRCUIT BOARD, PLUS THE COMPONENTS THEREON, COMPRISE THE 16-218 ASSY.

3. NUMBERS MARKED ◯ REFER TO TERMINALS ON THE 14-125C CIRCUIT BOARD.

2. COMPONENTS NUMBERED BETWEEN 200 & 299 (EXCEPT J201) ARE LOCATED ON THE 14-125C CIRCUIT BOARD.

1. COMPONENTS INSIDE THE DOTTED LINE ARE MOUNTED ON A TERMINAL STRIP BEHIND THE 14-125C CIRCUIT BOARD.

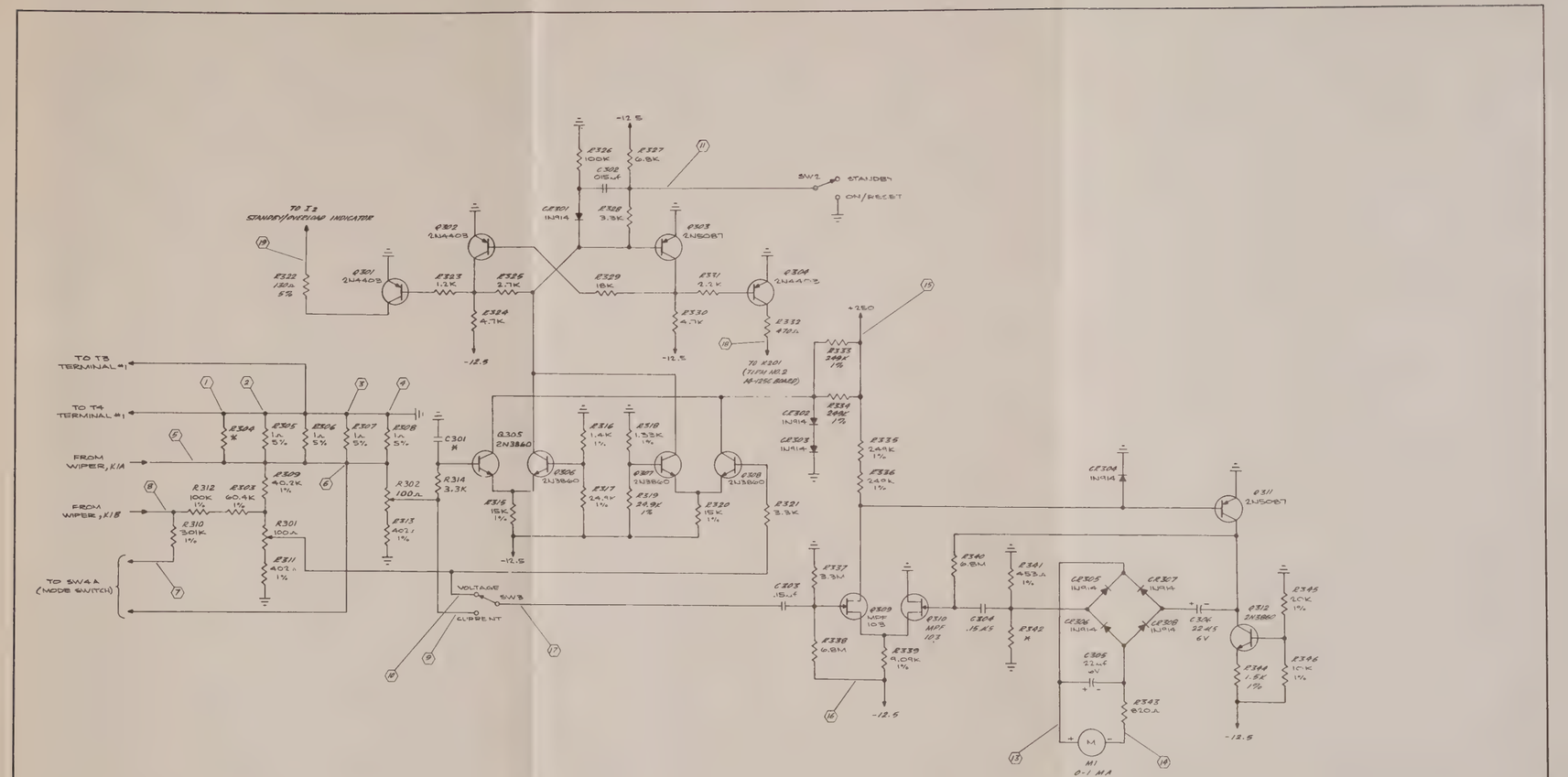
NOTES:

| | | |
|---|---|---|
| SCALE: —— | APPROVED BY: Hal W. Hale Lang L. | DRAWN BY CLAB |
| DATE 24 SEPT 68 | | REVISED |

POWER AMPLIFIER DRIVER

NH RESEARCH, INC. SANTA ANA, CALIF.

DRAWING NUMBER 10-717




NOTES:

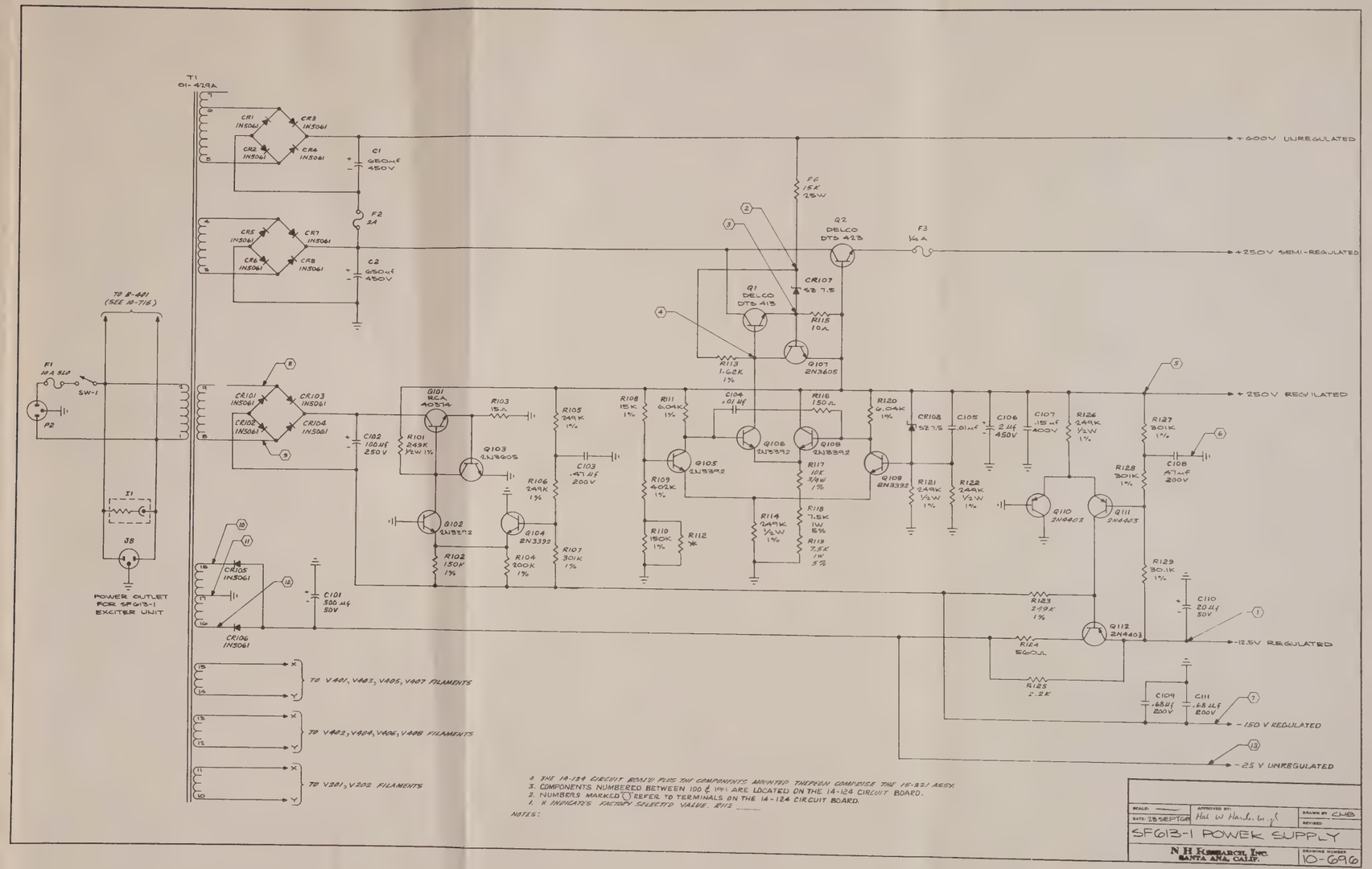
1. * INDICATES FACTORY SELECTED VALUE, AS REQD. C301 _____, R304 _____, R342 _____
2. NUMBERS MARKED ⬡ REFER TO TERMINALS ON THE 18-126 CIRCUIT BOARD.
3. COMPONENTS NUMBERED BETWEEN 300 & 399 ARE LOCATED ON THE 18-126 CIRCUIT BOARD.
4. THE COMPONENTS SHOWN ON THIS SCHEMATIC COMPRISE THE 15-068 ASSY & THE 15-044 ASSY.

| | | |
|---|---|---|
| SCALE —— | APPROVED BY Hal W Hall | DRAWN BY CL |
| DATE: 10-4-68 | | REVISED |

METERING & OVERLOAD CIRCUIT

NH RESEARCH, INC. SANTA ANA, CALIF.

DRAWING NUMBER 10-704




NOTES:

1. * INDICATES FACTORY SELECTED VALUE. R113 ____
2. NUMBERS MARKED (○) REFER TO TERMINALS ON THE 14-124 CIRCUIT BOARD.
3. COMPONENTS NUMBERED BETWEEN 100 & 199 ARE LOCATED ON THE 14-124 CIRCUIT BOARD.
4. THE 14-124 CIRCUIT BOARD PLUS THE COMPONENTS MOUNTED THEREON COMPRISE THE 16-221 ASSY.

| | | |
|---|---|---|
| SCALE: | APPROVED BY: Hal W Hamilton | DRAWN BY: CWB |
| DATE: 28 SEPT 66 | | REVISED |

SF613-1 POWER SUPPLY

N H RESEARCH, INC. SANTA ANA, CALIF.

DRAWING NUMBER 10-6996

## SECTION 7

## PARTS PROVISIONING LIST AND COMPONENT LOCATIONS

### 7.1 REPLACEMENT PARTS

7.2 To obtain replacement parts, find the manufacturer's part number and description in this manual and then refer to the appropriate Repair Parts and Special Tools List (RPSTL) TM. In the RPSTL, find the assembly or subassembly first and then the description which corresponds with that in this manual. Under the description in the RPSTL find the manufacturer's part number, and then order the part by the listed Federal Stock Number. If the part is not listed in the RPSTL, it should be requisitioned from the NICP in accordance with AR 725-50.

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C1 | 650µf, 450V, Electrolytic | MALLORY | CG651T450 EF3H | 37942 | |
| C2 | 650µf, 450V, Electrolytic | MALLORY | CG651T450 EF3H | 37942 | |
| C3A | 3300pf, ±5%, 500V | CENTRALAB | CPR3300J | 71590 | |
| C3B | 3300pf, ±5%, 500V | CENTRALAB | CPR3300J | 71590 | |
| C3C | 3300pf, ±5%, 500V | CENTRALAB | CPR3300J | 71590 | |
| C4A | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4B | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4C | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4D | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4E | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4F | 3600pf, ±5%, 500V | CENTRALAB | CPR3600J | 71590 | |
| C4G | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| C4H | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| C4I | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| C4J | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| C4K | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C4L | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| C4M | 3900pf, ±5%, 500V | CENTRALAB | CPR3900J | 71590 | |
| CR1 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR2 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR3 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR4 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR5 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR6 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR7 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR8 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| F1 | Fuse 10A Slo | BUSS | FNM | 71400 | |
| F2 | Fuse 2A | BUSS | BBS | 71400 | |
| F3 | Fuse 1/4A | BUSS | AGC | 71400 | |
| I1 | Indicator Light | ELDEMA | BG03RCSNE 2H33KRed | 03797 | |
| I2 | Indicator Light | ELDEMA | BF03-ACS-1762 | 03797 | |
| | | | | | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| J1 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| J2 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| J3 | Socket Receptacle, Red | Sup.Elec. | RS25G | 58474 | |
| J4 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| J5 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| J6 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| J7 | Socket Receptacle, Red | SUP.ELEC. | RS25G | 58474 | |
| K1 | Relay, DPDT, 120V AC | P&B | KAP11AG | 77342 | |
| K2 | Relay, DPDT, 120V AC | P&B | KAP11AG | 77342 | |
| L1 | Choke | NHR | 01-443 | 24862 | |
| M1 | Meter, 0-1 ma DC | NHR | 18-001 | 24862 | |
| P1 | Plug Receptacle, Black | SUP.ELEC. | RP25G | 58474 | |
| P2 | Line Cord | BELDEN | 17419-S | 70903 | |
| Q1 | Transistor Silicon Power | DELCO | DTS 413 | 16758 | |
| Q2 | Transistor Silicon Power | DELCO | DTS 423 | 16758 | |
| R1 | 1K Potentiometer | OHMITE | CMU1021 | 44655 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R2 | 72 ohm, 175W, Non-inductive | DALE | NHL-175 | 91637 | |
| R3 | 72 ohm, 175W, Non-Inductive | DALE | NHL-175 | 91637 | |
| R4 | 220 ohm, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R5 | 1 ohm, 25W | OHMITE | 0200J | 44655 | |
| R6 | 15K, 25W | OHMITE | 0217 | 44655 | |
| SW1 | Toggle Switch, DPDT | JBT | MS25100-23 | 31356 | |
| SW2 | Toggle Switch, DPDT | JBT | MS25100-23 | 31356 | |
| SW3 | Rotary Switch, SPDT Shorting | CENTRALAB | 1460 | 71590 | |
| SW4 | Rotary Switch, 3PDT Non-Shorting | CENTRALAB | PA1007 | 71590 | |
| SW5 | Toggle Switch, DPDT | JBT | MS25100-23 | 31356 | |
| T1 | Transformer, Power | NHR | 01-429U | 24862 | |
| T2 | Transformer, Output | NHR | 01-427A | 24862 | |
| T3 | Auto Transformer, Step-Up | NHR | 01-426 | 24862 | |
| T4 | Auto Transformer, Step-Down | NHR | 01-428A | 24862 | |
| TP1 | Tip Jack, Red | E.F.Johnson | 105-602 | 74970 | |
| TP2 | Tip Jack, Red | E.F.Johnson | 105-602 | 74970 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| TP3 | Tip Jack, Black | E.F.Johnson | 105-603 | 74970 | |
| 14-124 | Circuit Board | NHR | 14-124 | 24862 | |
| 14-125 | Circuit Board | NHR | 14-125C | 24862 | |
| 14-126 | Circuit Board | NHR | 14-126 | 24862 | |
| C101 | 500µf, 50V, Electrolytic | SPRAGUE | 39D-507G 050EL4 | 56289 | |
| C102 | 100µf, 250V, Electrolytic | SPRAGUE | 39D-107F 250HL4 | 56289 | |
| C103 | 0.47µf, 200V, Mylar | C/D | WMF2P47 | 14655 | |
| C104 | 0.01µf, 100V, Mylar | C/D | WMF 1S1 | 14655 | |
| C105 | 0.01µf, 100V, Mylar | C/D | WMF 1S1 | 14655 | |
| C106 | 2µf, 450V, Electrolytic | SPRAGUE | TVA1701 | 56289 | |
| C107 | 0.15µf. 400V, Mylar | C/D | WMF4P15 | 14655 | |
| C108 | 0.47µf, 200V, Mylar | C/D | WMF2P47 | 14655 | |
| C109 | 0.68µf, 200V, Mylar | C/D | WMF2P68 | 14655 | |
| C110 | 20µf, 50V, Electrolytic | MALLORY | MTA20E50 | 37942 | |
| C111 | 0.68µf, 200V, Mylar | C/D | WMF2P68 | 14655 | |
| CR101 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| CR102 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR103 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR104 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR105 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR106 | Diode Silicon Power | G.E. | 1N5061 | 03508 | |
| CR107 | Zener Diode, 7.5V, 1W, 10% | SCHAUER | SZ 7.5 | 81071 | |
| CR108 | Zener Diode, 7.5V 1W, 10% | SCHAUER | SZ 7.5 | 81071 | |
| Q101 | Transistor Silicon Power | RCA | 40374 | 49671 | |
| Q102 | Transistor Silicon | G.E. | 2N3392 | 03508 | |
| Q103 | Transistor Silicon | G.E. | 2N3605 | 03508 | |
| Q104 | Transistor Silicon | G.E. | 2N3391 | 03508 | |
| Q105 | Transistor Silicon | G.E. | 2N3391 | 03508 | |
| Q106 | Transistor Silicon | G.E. | 2N3392 | 03508 | |
| Q107 | Transistor Silicon | G.E. | 2N3605 | 03508 | |
| Q108 | Transistor Silicon | G.E. | 2N3392 | 03508 | |
| Q109 | Transistor Silicon | G.E. | 2N3392 | 03508 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| Q110 | Transistor Silicon | MOTOROLA | 2N4403 | 04713 | |
| Q111 | Transistor Silicon | MOTOROLA | 2N4403 | 04713 | |
| Q112 | Transistor Silicon | MOTOROLA | 2N4403 | 04713 | |
| R101 | 249K, 1/2W, 1%, Metal Film | Corning | NA65 | 07115 | |
| R102 | 150K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R103 | 15 ohm, 1/2W, 10%, Carbon Comp | OHMITE | RC20GF | 44655 | |
| R104 | 200K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R105 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R106 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R107 | 301K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R108 | 15K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R109 | 402K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R110 | 150K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R111 | 6.04K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R112 | Selected Resistor | -- | -- | -- | |
| R113 | 1.62K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R113 | 1.62K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R114 | 249K, 1/2W, 1% Metal Film | Corning | NA65 | 07115 | |
| R115 | 10 ohm, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R116 | 150 ohm, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R117 | 10K, 3/4W, 1%, Metal Film | Corning | NA-70 | 07115 | |
| R118 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R119 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R120 | 6.04K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R121 | 249K, 1/2W, 1%, Metal Film | Corning | NA65 | 07115 | |
| R122 | 249K, 1/2W, 1%, Metal Film | Corning | NA65 | 07115 | |
| R123 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R124 | 560 ohm, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R125 | 2.2K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R126 | 249K, 1/2W, 1%, Metal Film | Corning | NA65 | 07115 | |
| R127 | 301K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R128 | 301K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R129 | 30.1K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C201 | 2.0µf, 200V Polycarbonate | C/D | MCR2W2 | 14655 | |
| C202 | 2.0µf, 200V Polycarbonate | C/D | MCR2W2 | 14655 | |
| C203 | .15µf, 200V Mylar | C/D | WMF2P15 | 14655 | |
| C204 | .15µf, 200V Mylar | C/D | WMF2P15 | 14655 | |
| C205 | 2.0µf, 200V Polycarbonate | C/D | MCR2W2 | 14655 | |
| C206 | 10pf, ±5%, 500V Silver Mica | ELMENCO | DM15-100J | 84171 | |
| C207 | 1.4 to 9.5pf Variable Capacitor | E.F.JOHNSON | 189-503-5 | 74970 | |
| C208 | 5pf, ±1pf, 500V Silver Mica | ELMENCO | DM15-050 | 84171 | |
| C209 | 2µf, 200V , Polycarbonate | C/D | MCR2W2 | 14655 | |
| C210 | 15pf, ±5%, 500V Silver Mica | ELMENCO | DM15-150J | 84171 | |
| C211 | 15pf, ±5%, 500V Silver Mica | ELMENCO | DM15-150J | 84171 | |
| C212 | 39pf, ±5%, 500V Silver Mica | ELMENCO | DM15-390J | 84171 | |
| C213 | 200pf, ±5%, 500V Silver Mica | ELMENCO | DM15-201J | 84171 | |
| C214 | 0.1µf, 200V Mylar | C/D | WMF2P1 | 14655 | |
| C215 | 0.47µf, 100V Mylar | C/D | WMF1P47 | 14655 | |
| C216 | 20pf, ±5%, 500V Silver Mica | ELMENCO | DM15-200J | 84171 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C217 | 18pf, ±5%, 500V Silver Mica | ELMENCO | DM15-180J | 84171 | |
| C218 | 0.0012μf, ±10%, 1000V Ceramic Disc | Centralab | DD122 | 71590 | |
| C219 | 0.0012μf, ±10%, 1000V Ceramic Disc | Centralab | DD122 | 71590 | |
| C220 | 5pf, ±1pf, 500V Silver Mica | Elmenco | DM15-050 | 84171 | |
| C221 | 2μf, 450V Electrolytic | Sprague | TVA-1701 | 56289 | |
| C222 | 0.33uf, 400V | C/D | WMF4P33 | 14655 | |
| CR201 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR202 | Diode Silicon | T.I. | 1N914 | 01295 | |
| J201 | Input Connector | Kings | KC-79-70 | 91836 | |
| K201 | Reed Relay, SPST, 12VDC, 1152 ohm | Struthers-Dunn | MRRIA | 78290 | |
| K202 | Reed Relay, SPST, 12VDC, 1152 ohm | Struthers-Dunn | MRRIA | 78290 | |
| Q201 | Selected Transistor, Field Effect, Silicon | Motorola | MPF151 or MPF152 | 04713 | |
| Q202 | Transistor, Silicon | Fairchild | 2N4889 | 07263 | |
| Q203 | Selected Transistor, Field Effect, Silicon | Motorola | MPF151 or MPF152 | 04713 | |
| Q204 | Transistor, Silicon | Fairchild | 2N4889 | 07263 | |
| Q205 | Transistor, Silicon | Fairchild | 2N4889 | 07263 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R201 | 50K, Potentiometer | Clarostat | 63M5 | 12697 | |
| R202 | 50K, Potentiometer | Clarostat | 63M5 | 12697 | |
| R203 | 5M, 1/4W, 1% Carbon Film | IRC | RN60D | 75042 | |
| R204 | 5M, 1/4W, 1%, Carbon Film | IRC | RN60D | 75042 | |
| R205 | 20K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R206 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R207 | 1K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R208 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R209 | 20K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R210 | 5M, 1/4W, 1% Carbon Film | IRC | RN60D | 75042 | |
| R211 | 5M, 1/4W, 1% Carbon Film | IRC | RN60D | 75042 | |
| R212 | 49.9K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R213 | 21.5K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R214 | 604K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R215 | 604K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R216 | 20K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R217 | 402K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R218 | 402K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R219 | 150K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R220 | 150K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R221 | 301K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R222 | 69.8K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R223 | 8.25K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R224 | 4.99K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R225 | 1.5K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R226 | 4.99K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R227 | 1.5K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R228 | 60.4K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R229 | 75K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R230 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R231 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R232 | 75K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R233 | 402 ohm, 1/4W, 1% Metal Film | Corning | NA60 | 07115 | |
| R234 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R235 | 7.5K, 1W, 5%, Metal Film | Corning | C-32 | 07115 | |
| R236 | 820K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 07115 | |
| R237 | 680K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R238 | 1K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R239 | 1.5K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| V201 | Dual Triode Tube | Sylvania | 6DJ8 | 11293 | |
| V202 | Dual Triode Tube | Sylvania | 6DJ8 | 11293 | |
| C301 | Selected | -- | -- | -- | |
| C302 | 0.015µf, ±10%, 100V Mylar | C/D | WMF1515 | 14655 | |
| C303 | 0.15µf, ±10%, 100V Mylar | C/D | WMF1P15 | 14655 | |
| C304 | 0.15µf, ±10%, 100V Mylar | C/D | WMF1P15 | 14655 | |
| C305 | Electrolytic, 22µf, 6V | KEMET | K22W6 | 05397 | |
| C306 | Electrolytic, 22µf, 6V | KEMET | K22W6 | 05397 | |
| CR301 | Diode Silicon | T.I. | 1N914 | 01295 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| CR302 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR303 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR304 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR305 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR306 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR307 | Diode Silicon | T.I. | 1N914 | 01295 | |
| CR308 | Diode Silicon | T.I. | 1N914 | 01295 | |
| Q301 | Transistor, Silicon | Motorola | 2N4403 | 04713 | |
| Q302 | Transistor, Silicon | Motorola | 2N4403 | 04713 | |
| Q303 | Transistor, Silicon | Motorola | 2N5087 | 04713 | |
| Q304 | Transistor, Silicon | Motorola | 2N4403 | 04713 | |
| Q305 | Transistor Silicon | G.E. | 2N3860 | 03508 | |
| Q306 | Transistor, Silicon | G.E. | 2N3860 | 03508 | |
| Q307 | Transistor, Silicon | G.E. | 2N3860 | 03508 | |
| Q308 | Transistor, Silicon | G.E. | 2N3860 | 03508 | |
| Q309 | Transistor, Silicon, Field Effect | Motorola | MPF 103 | 04713 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| Q310 | Transistor, Silicon, Field Effect | Motorola | MPF103 | 04713 | |
| Q311 | Transistor, Silicon | Motorola | 2N5087 | 04713 | |
| Q312 | Transistor, Silicon | G.E. | 2N3860 | 03508 | |
| R301 | 100 ohm, Potentiometer | Clarostat | 63M5 | 12697 | |
| R302 | 100 ohm potentiometer | Clarostat | 63M5 | 12697 | |
| R303 | 60.4K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R304 | 1 ohm, 1/2W, 5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R305 | 1 ohm, 1/2W, 5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R306 | 1 ohm, 1/2W, 5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R307 | 1 ohm, 1/2W, 5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R308 | 1 ohm, 1/2W, 5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R309 | 40.2K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R310 | 301K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R311 | 402 ohm, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R312 | 100K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R313 | 402 ohm, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R314 | 3.3K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R315 | 15K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R316 | 1.4K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R317 | 24.9K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R318 | 1.33K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R319 | 24.9K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R320 | 15K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R321 | 3.3K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R322 | 130 ohm, 1/2W, 5%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R323 | 1.2K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R324 | 4.7K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R325 | 2.7K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R326 | 100K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R327 | 6.8K, 1/2W, 10% Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R328 | 3.3K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R329 | 18K, 1/2W, 10%, Carbon Comp | Ohmite | RC20GF | 44655 | |
| R330 | 4.7K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R331 | 2.2K, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R332 | 470 ohm, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R333 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R334 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R335 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R336 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R337 | 3.3M, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R338 | 6.8M, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R339 | 9.09K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R340 | 6.8M, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R341 | 453 ohm, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R342 | Selected, 1/2W, 10% Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R343 | 820 ohm, 1/2W, 10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R344 | 1.5K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R345 | 20K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R346 | 10K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| C401 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C402 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C403 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C404 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C405 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C406 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C407 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C408 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C409 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C410 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C411 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| C412 | 0.0012µf, 1000V, Ceramic disc. | Centralab | DD122 | 71590 | |
| B401 | Fan | Rotron | Venturi | 82877 | |
| R401 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R402 | 15 ohm, 1/2W, ±10% Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R403 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R404 | 39 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R405 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R406 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R407 | 15 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R408 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R409 | 39 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R410 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R411 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R412 | 15 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R413 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R414 | 39 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R415 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R416 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R417 | 15ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R418 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R419 | 39 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
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| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R420 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R421 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R422 | 15 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R423 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R424 | 39 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R425 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R426 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R427 | 15 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R428 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R429 | 39 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R430 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R431 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R432 | 15 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R433 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R434 | 39 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R435 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R436 | 100 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R437 | 15 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R438 | 1 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R439 | 39 ohm, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R440 | 130 ohm, 1/2W, ±5%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| V401 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V402 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V403 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V404 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V405 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V406 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V407 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| V408 | Tube | Sylvania | 8417 | 11293 | 15-041 |
| CR501 | Diode Silicon | T.I. | 1N914 | 01295 | |
| K501 | Relay, SPST, 12V DC, 1152 ohm | Struthers-Dunn | MRRIA | 78290 | |
| Q501 | Transistor, Silicon | G.E. | 2N3392 | 03508 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R501 | 4.99K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R502 | 68K, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R503 | 1.5K, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| C601 | 3pf, ±0.5pf, 500V, Silver Mica | Elmenco | DM15030 | 84171 | |
| C602 | 20pf, ±5%, 500V, Polystyrene | Centralab | CPR20J | 71590 | |
| C603 | 3pf, ±0.5pf, 500V, Silver Mica | Elmenco | DM15030 | 84171 | |
| C604 | 20pf, ±5%, 500V, Polystyrene | Centralab | CPR20J | 71590 | |
| C605 | 3pf, ±5%, 500V, Silver Mica | Elmenco | DM15030 | 84171 | |
| C606 | 20pf, ±5%, 500V, Polystyrene | Centralab | CPR20J | 71590 | |
| R601 | 680K, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R602 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R603 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R604 | 680K, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| R605 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R606 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R607 | 680K, 1/2W, ±10%, Carbon Comp. | Ohmite | RC20GF | 44655 | |
| | | | | | |

| REF. NO. | DESCRIPTION | MFGR. | MFGR. PART NUMBER | FEDERAL STOCK CODE | NHR PART NO. (WHERE APP.) |
|---|---|---|---|---|---|
| R608 | 249K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| R609 | 200K, 1/4W, 1%, Metal Film | Corning | NA60 | 07115 | |
| | | | | | |
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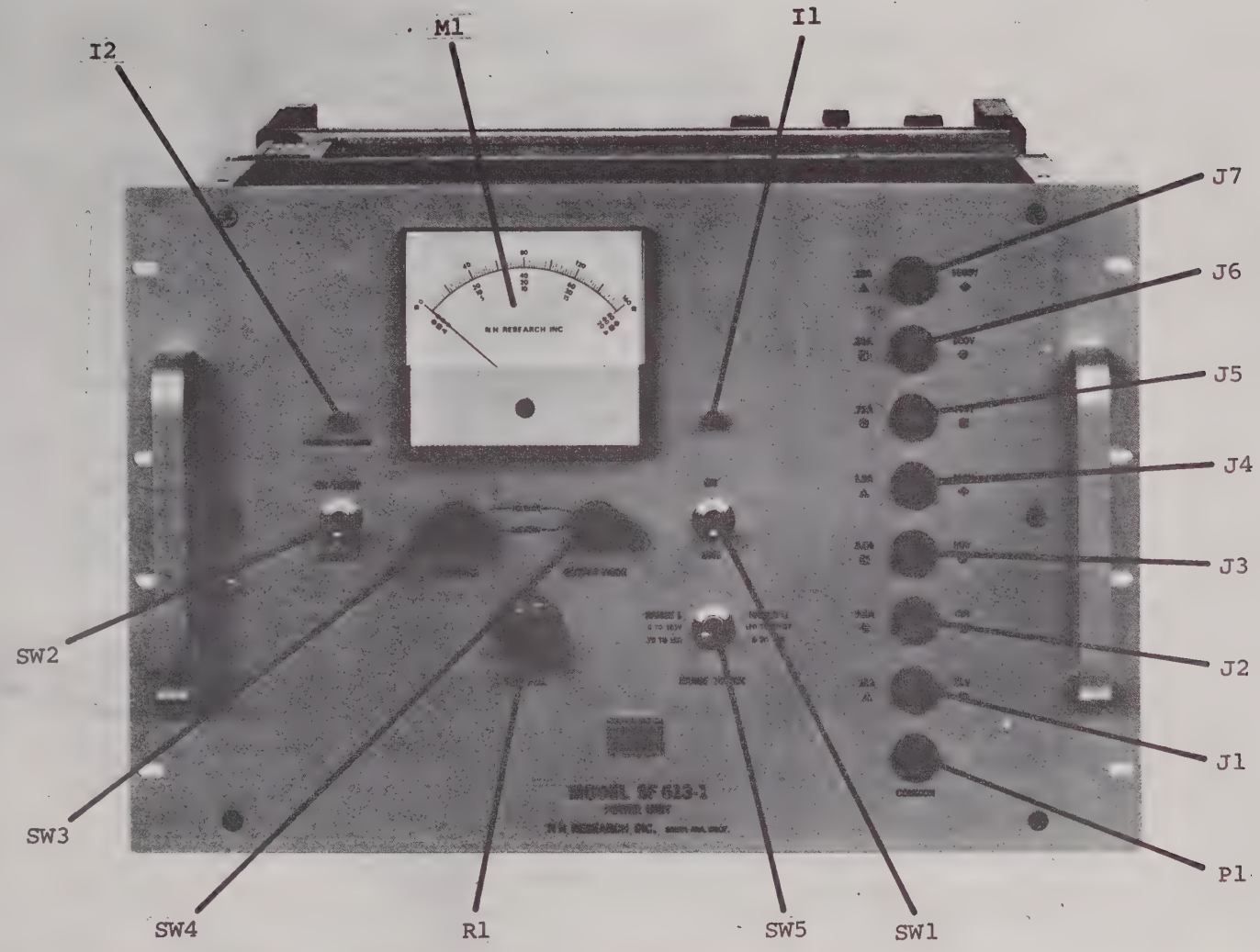
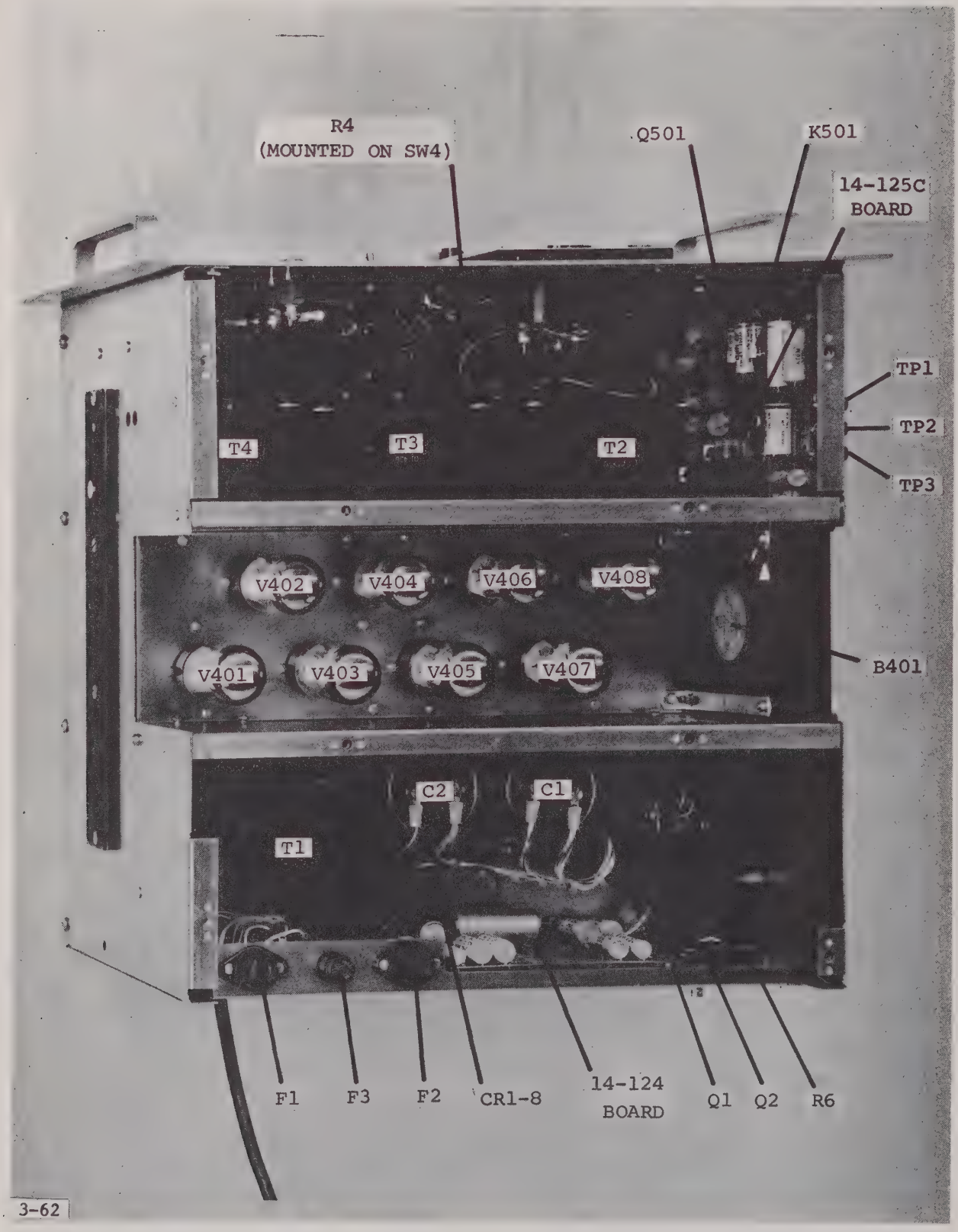
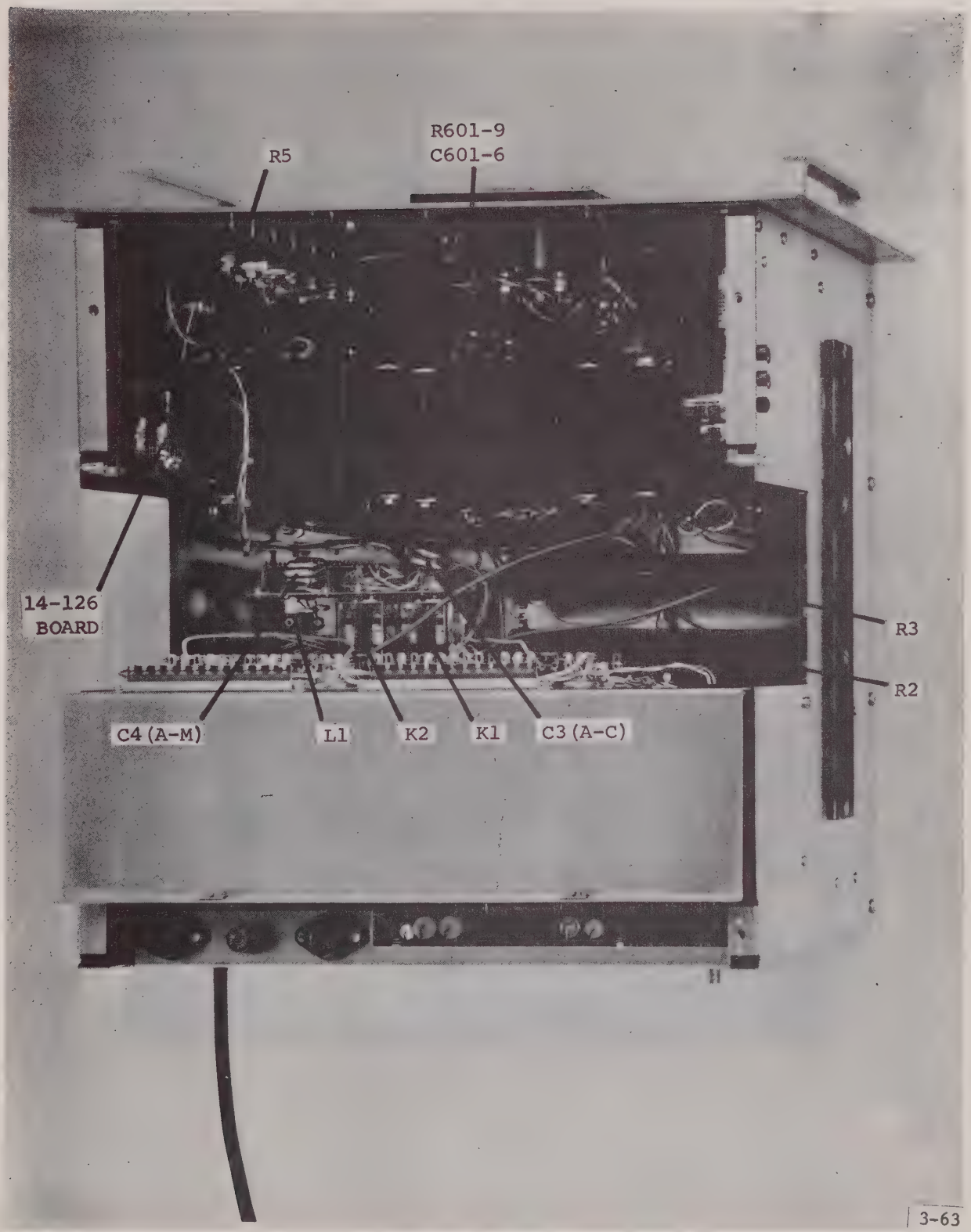
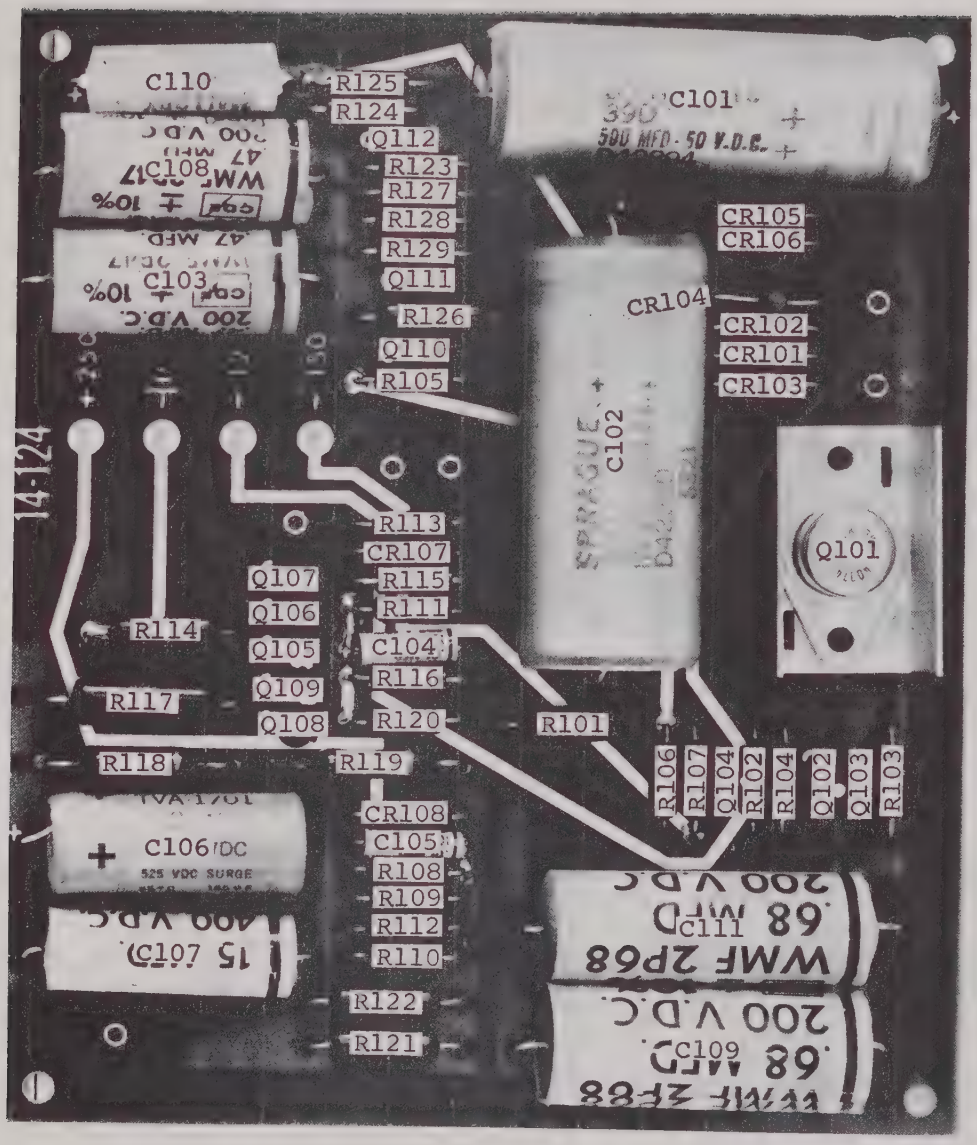
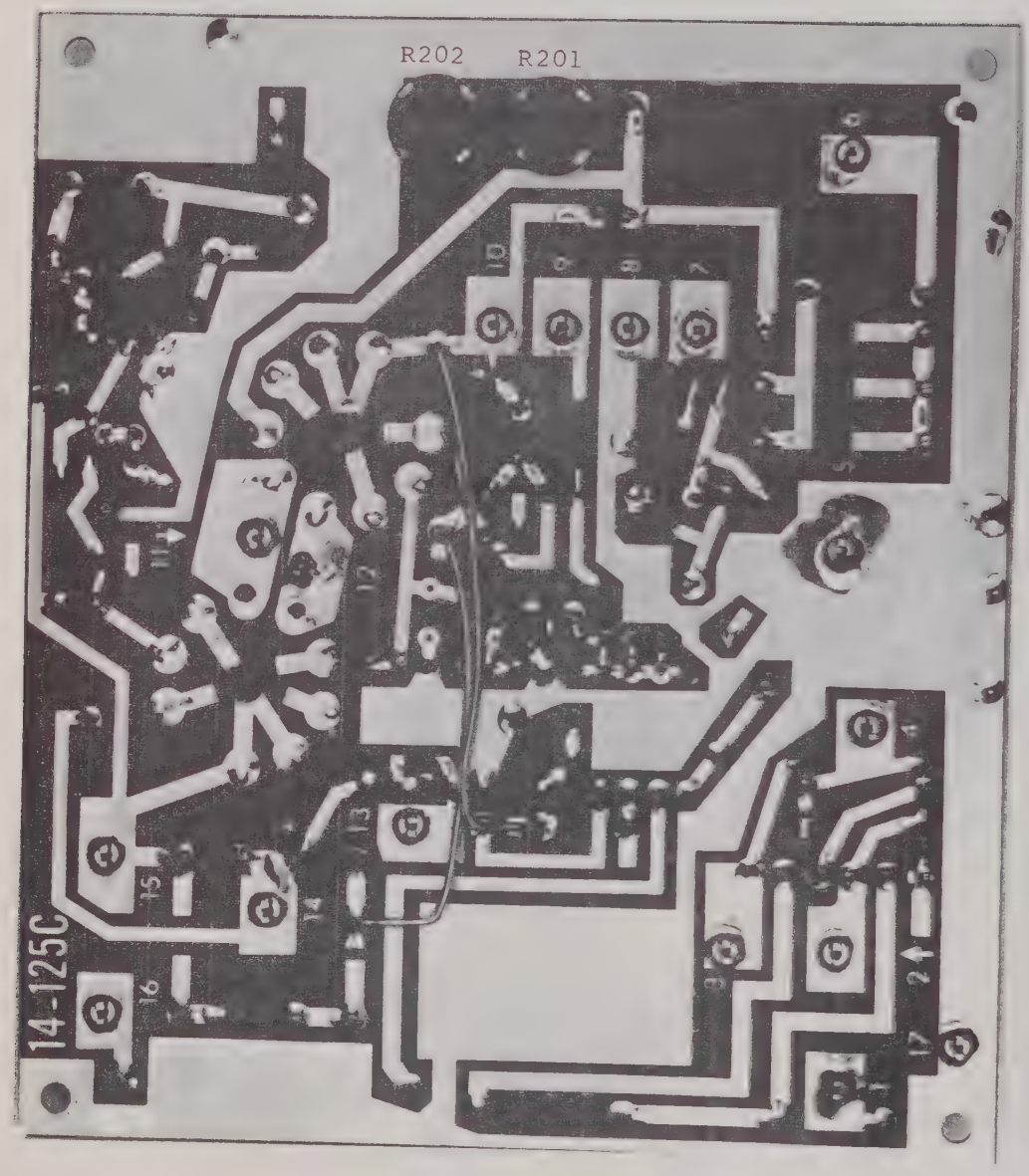

I2
M1
I1
J7
J6
J5
J4
J3
J2
J1
P1
SW2
SW3
SW4
R1
SW5
SW1

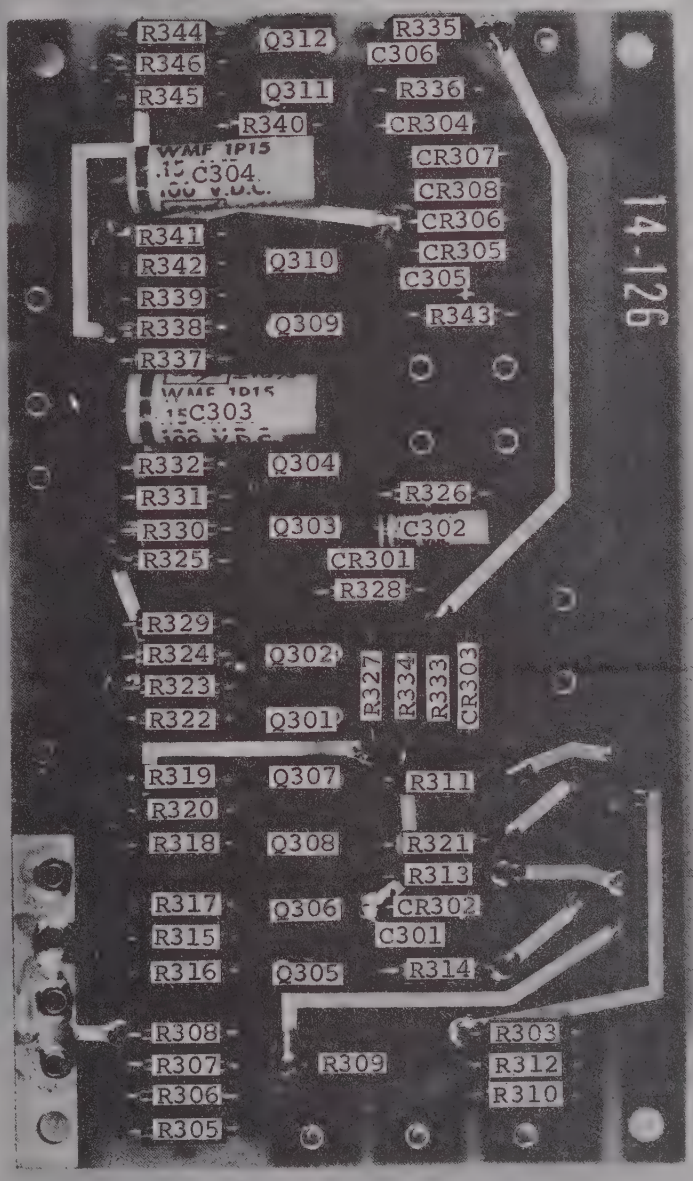

R4
(MOUNTED ON SW4)
Q501
K501
14-125C
BOARD
TP1
TP2
TP3
T4
T3
T2
V402
V404
V406
V408
V401
V403
V405
V407
B401
C2
C1
T1
F1
F3
F2
CR1-8
14-124
BOARD
Q1
Q2
R6


R601-9
C601-6
R5
14-126
BOARD
R3
R2
C4 (A-M)
L1
K2
K1
C3 (A-C)


C110
R125
R124
C101
500 MFD - 50 V.D.C.
Q112
R123
R127
R128
R129
Q111
R126
Q110
R105
CR105
CR106
CR104
CR102
CR101
CR103
C102
SPRAGUE
Q101
14-124
R113
CR107
Q107
R115
Q106
R111
R114
Q105
C104
R116
Q109
R117
Q108
R120
R101
R118
R119
R106
R107
Q104
R102
R104
Q102
Q103
R103
CR108
C105
C106
525 VDC SURGE
R108
R109
R112
R110
R122
R121
68 MFD
200 V.D.C.
WMF 2P68

14-125C
R231
R230
R235
R234
C205
2.0 MFD 200 VDC
MCR 2W2
2.0 M C202 VDC
MCR 2W2
2.0 M C201 VDC
K202
K201
R239
CR201
R240
CR202
R232
R236
R237
R227
R226
C219
R216
C211
C210
R205
R209
R212
R211
R210
C204
.15 MFD
200 V.D.C.
WMF 2P15
.47 C215
100 V.D.C.
C214
.1
200 V.D.C.
R208
R206
R238
R207
C222
.33 MFD.
SPRAGUE
ATOM
C221
2 MF.
V201
R229
C212
R217
R221
Q203
Q204
Q205
R223
R213
C216
R218
R219
R220
R233
R228
C220
C213
V202
R222
C217
R225
Q202
C218
R224
R214
C206
Q201
R203
C208
R215
C207
R204
C209
2.0 MFD 200 VDC
MCR 2W2
C203
20
WMF 2P15
.15 MFD


R202
R201
14-125C


R344
Q312
R335
C306
R346
R345
Q311
R336
R340
CR304
WMF 1P15
.15 C304
CR307
CR308
CR306
R341
CR305
R342
Q310
C305
R339
R338
Q309
R343
R337
WMF 1D15
.15C303
R332
Q304
R331
R326
R330
Q303
C302
R325
CR301
R328
R329
R324
Q302
R323
R322
Q301
R327
R334
R333
CR303
R319
Q307
R311
R320
R318
Q308
R321
R313
R317
Q306
CR302
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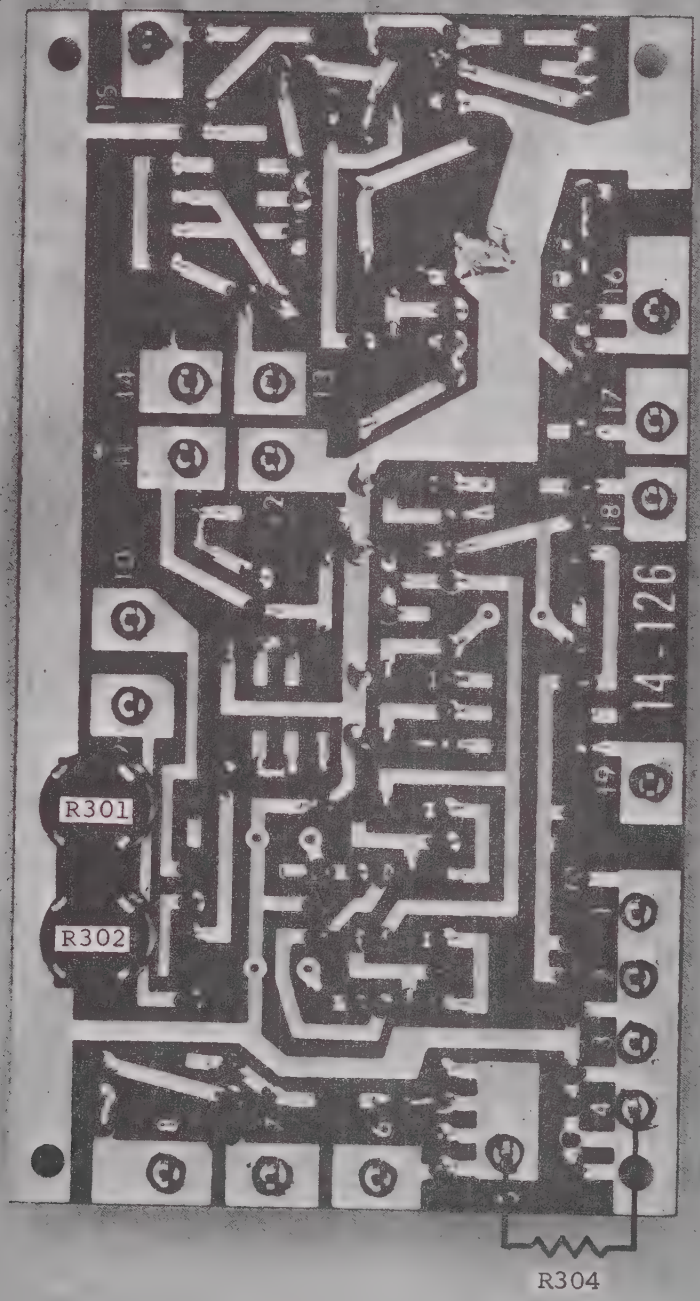
R312
R306
R310
R305
14-126


R301
R302
14-126
R304

# CHAPTER 4

# PREVENTIVE MAINTENANCE AND MODIFICATION

## SECTION 1

## PREVENTIVE MAINTENANCE INSTRUCTIONS

### 1.1 SCOPE OF MAINTENANCE

1.2 The maintenance duties assigned to operator and organizational repairman of this equipment are listed below with a reference to the paragraphs covering the specific maintenance functions. The preventive maintenance procedures require no special tools or test equipment.

*a.* Daily preventive maintenance checks and services (para 1.8)
*b.* Weekly preventive maintenance checks and services (para 1.9)
*c.* Monthly preventive maintenance checks and services (para 1.10)
*d.* Quarterly preventive maintenance checks and services (para 1.13)
*e.* Cleaning (para 1.16)
*f.* Touchup painting instructions (para 1.18)

### 1.3 MATERIALS REQUIRED FOR MAINTENANCE

*a.* Trichloroethane (6810-292-2625).

> The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT use near an open flame. Trichloroethane is not flammable, but exposure of the fumes to an open flame converts the fumes to highly toxic, dangerous gases.

*b.* Cleaning cloth.
*c.* Fine sandpaper.
*d.* Touchup paint.

### 1.4 PREVENTIVE MAINTENANCE

1.5 Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

*a.* Systematic Care. The procedure given in paragraphs 1.6 through 1.9 covers routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

*b.* Preventive Maintenance Checks and Services. The maintenance checks and services charts outline functions to be performed at specific intervals. These checks and services are to maintain equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and the normal conditions. The reference column lists the paragraphs that contain additional information. If the defect cannot be found by performing the corrective action indicated, a higher category of maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38-750.

## 1.6 PREVENTIVE MAINTENANCE CHECKS AND SERVICES PERIODS

1.7 Preventive maintenance checks and services of this equipment are required daily, weekly, monthly, and quarterly. Daily maintenance checks and services are specified in paragraph 1.8. Paragraph 1.9 specifies checks and services that must be performed weekly. If the equipment is maintained in a standby condition, the daily and weekly checks should be accomplished at the same time. The maintenance checks and services that are accomplished monthly are specified in paragraph 1.11. Quarterly maintenance checks and services are specified in paragraph 1.14.

## 1.8 DAILY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

| Sequence No. | Items to be inspected. | Procedure | Reference |
|---|---|---|---|
| 1 | Completeness | See that the equipment is complete. | Appendix |
| 2 | Cleanliness | Exterior of equipment must be clean and dry, free of fungus, dirt, dust, and grease. | Paragraph 1.16 |
| 3 | Operational check. | Check the operational efficiency. | |
| 4 | Controls | See that controls operate smoothly and are fastened in place securely. | |

## 1.9 WEEKLY PREVENTIVE MAINTENANCE AND SERVICES CHART

| Sequence No. | Items to be inspected. | Procedure | Reference |
|---|---|---|---|
| 1 | Cables | Inspect cards and cables for chafed, cracked, or frayed insulation. Replace connectors that are broken, stripped, or worn. | |
| 2 | Metal surfaces | Inspect exposed metal surface for rust and corrosion. Clean and touchup with paint as required. | Paragraphs 1.16 and 1.18 |

## 1.10 MONTHLY MAINTENANCE

1.11 Perform the maintenance functions indicated in the monthly preventive maintenance checks and services chart (para 1.12) once each month. Periodic daily (para 1.8) and weekly (para 1.9) services constitute a part of the monthly checks.

## 1.12 MONTHLY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

| Sequence No. | Items to be inspected. | Procedure |
|---|---|---|
| 1 | Terminations | Inspect for loose connections and cracked or broken insulation. |
| 2 | Control panel | Clean panel thoroughly and check all surfaces for chips, cracks, and abnormal wear. |
| 3 | Hardware | Inspect all hardware for possible damage. |
| 4 | Air fan | Clean. |

## 1.13 QUARTERLY MAINTENANCE

1.14 Quarterly preventive maintenance checks and services are required for this equipment. Periodic daily, weekly, and monthly services constitute a part of the quarterly preventive maintenance checks and services and must be performed concurrently. All deficiencies or shortcomings will be recorded in accordance with the requirements of TM 38-750. Perform all the checks and services listed in the quarterly preventive maintenance checks and services chart (para 1.15) in the sequence listed. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions.

## 1.15 QUARTERLY PREVENTIVE MAINTENANCE CHECKS AND SERVICES CHART

| Sequence No. | Items to be inspected. | Procedure | Reference |
|---|---|---|---|
| 1 | Publications | See that all publications are complete, serviceable, and current. | DA Pam 310-4 |
| 2 | Modifications | Check DA Pam 310-7 to determine whether new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All normal MWO's must be scheduled. | TM 38-750 and DA Pam 310-7. |

## 1.16 CLEANING

1.17 Inspect the exterior surfaces. The surfaces must be free of dust, dirt, grease, and fungus.

*a.* Remove dust and loose dirt with a clean, soft cloth.

*b.* Remove grease, fungus, and ground-in dirt. Use a damp cloth (not wet) with trichloroethane to clean terminations. If dirt on the body of the unit is difficult to remove, use mild soap and water.

*c.* Remove dust or dirt from the jacks and plugs with a brush.

## 1.18 TOUCHUP PAINTING INSTRUCTIONS

1.19 Remove dust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TB 746-10.

# SECTION 2

# MODIFICATION

## 2.0 MODIFICATION OF AC PRECISION POWER SUPPLY, NH RESEARCH SF 613-1, MIS-10222A.

*a. Bleeder Resistor:* The high voltage power supply of the SF 613-1 was designed without "bleeder" resistors. As a result, it is possible to receive an electrical shock from capacitors C1 and C2. This situation can be elinated by installing 10 watt, approximately 25 kilohm resistors across capacitors C1 and C2. The resistor lead wires can be connected by loosening the terminal screws of the capacitors, wrapping the lead wires around the screws under the terminal lugs, and tightening them down again. The resistor body should be at least 1/2 inch from the capacitor to keep the heat away from the capacitor. The following informa-

tion is furnished for requisitioning the needed resistors: Resistor, fixed ww 10w 24.9K ohms Federal Stock Number 5905-945-7057.

*b. Transient Pulse:* A 30- to 50-volt transient pulse with a width of about 10 to 25 miliseconds is present at the output terminals of this power supply when it is turned on or off. These transient pulses have sufficient amplitude and width to damage thermoelements, such as the Ballantine 1394 coaxial termal converters. To prevent possible damage, it is recommended that the gain control on the driver to set to zero, the ON/RESET-STANDBY switch be set to STANDBY, and the output leads be disconnected when the ac line power is turned on or off.

# Section 5. REPAIR PARTS LIST

## 5-0. INTRODUCTION

This section lists repair parts that are required for maintenance of Ac Precision Power Supply, NH Research, Inc. Model SF 613-1 and is applicable to Army Area Calibration Teams (AACT's).

NOTE

Throughout this section, DS is used to indicate AACT.

## 5-1. GENERAL

This section is divided as follows:

(1) Repair Parts List. A list, in alphabetical sequence, of repair parts authorized for the performance of maintenance at the AACT support level.

(2) National Stock Number and Reference Number Index. A list, in ascending numerical sequence, of all National stock numbers (NSN's) appearing in the repair parts list, followed by a list of all reference numbers in alpha-meric sequence appearing in the list. The NSN's and reference numbers are cross-referenced to a figure number and item number in column 10.

NOTE

The figure and item number columns represent cross-reference numbers, since illustrations are not included in this section.

Refer to section I of TM 9-4931-700-34P for explanation of columns (para 3), special information (para 4, except for subparagraph *40* which is not applicable to this section), and abbreviations (para 6).

## 5-2. HOW TO LOCATE REPAIR PARTS

When NSN or reference number is unknown, use the repair parts listing and locate the item by description.

When National stock number or reference number is known, use the list of NSN's or the reference numbers and locate the cross-referenced figure and item numbers. Locate the cross-referenced figure and item number under column 10 of the repair parts list for the complete description of the repair part.

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION<br>REFERENCE NUMBER & MFR CODE — USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP ONTHCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO | (b) ITEM NO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | GROUP 2000<br>POWER SUPPLY,AC PRECISION<br>SF613-1 24862<br>MIS10222TYPE1 18876 | | | | | | | | | | | | |
| PAFDL | 4931-00-4506697 | AMPLIFIER MODULE BOARD.....<br>M404G1 (88865) | EA | 1 | * | * | * | * | * | * | | 7 | 1 | 3 |
| PAFDL | 4931-00-4506698 | AMPLIFIER MODULE BOARD.....<br>M404G2 (88865)<br>CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 1 | 5 |
| PADZZ | 5910-00-7265003 | CAPACITOR,FIXED,ELECTROLYTIC.....<br>150D105X0035A2 (56289) | EA | 5 | | | | * | * | * | | * | 1 | 7 |
| PADZZ | 5910-00-9578578 | CAPACITOR,FIXED,MICA DIELECTRIC 500 V DC, 24 UUF (+- 5 0/0)<br>CM05ED240J03 (81349) | EA | 2 | | | | | | | | 10 | 1 | 9 |
| PADZZ | 5910-00-8352710 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 50 V.. DC,10,000 UUF,TYPE CTM103VAJ<br>CTM103VAJ (81349) | EA | 1 | | | | | | | | * | 1 | 11 |
| PADZZ | 5910-00-9574731 | CAPACITOR,FIXED,PLASTIC DIELECTRIC.....<br>WMF2D1 (14655) | EA | 1 | | | | | | | | 5 | 1 | 13 |
| PADZZ | 5910-00-8820091 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 100 V. DC,10,000 UUF (+- 20 0/0)<br>WMF1S1 (14655) | EA | 1 | | | | | | | | * | 1 | 15 |
| PAFZZ | 6210-00-4146784 | INDICATOR,LIGHT.....<br>BF03ACS1762 (03797) | EA | 1 | * | * | * | * | * | * | | 7 | 1 | 17 |
| PADZZ | 5905-00-1145425 | RESISTOR,FIXED,COMPOSITION 1/2 W,3,600... OHMS,TYPE RCR20G362JS (+- 5 0/0)<br>RCR20G362JS (81349) | EA | 1 | | | | | | | | 5 | 1 | 19 |
| PADZZ | 5905-00-1045755 | RESISTOR,FIXED,COMPOSITION 1/2 W,10 OHMS, TYPE RCR20G100JS (+- 5 0/0)<br>RCR20G100JS (81349) | EA | 2 | | | | | | | | * | 1 | 21 |
| PADZZ | 5905-00-1410591 | RESISTOR,FIXED,COMPOSITION 1/2 W,10,000.. OHMS,TYPE RCR20G103JS (+- 5 0/0)<br>RCR20G103JS (81349) | EA | 2 | | | | | | | | 10 | 1 | 23 |
| PADZZ | 5905-00-1134853 | RESISTOR,FIXED,COMPOSITION 1/2 W,1.3 MEG, TYPE RCR20G135JS (+- 5 0/0)<br>RCR20G135JS (81349) | EA | 1 | | | | | | | | 5 | 1 | 25 |
| PADZZ | 5905-00-1118357 | RESISTOR,FIXED,COMPOSITION 1/2 W,680..... OHMS,TYPE RCR20G681JS (+- 5 0/0)<br>RCR20G681JS (81349) | EA | 1 | | | | | | | | 5 | 1 | 27 |
| PADZZ | 5905-00-9358545 | RESISTOR,FIXED,COMPOSITION 1/2 W,18,000.. OHMS,TYPE RCR20G183JS (+- 5 0/0)<br>RCR20G183JS (81349) | EA | 1 | | | | | | | | * | 1 | 29 |
| PADZZ | 5905-00-9358539 | RESISTOR,FIXED,COMPOSITION 1/2 W,2,000... OHMS,TYPE RCR20G202JS (+- 5 0/0)<br>RCR20G202JS (81349) | EA | 1 | | | | | | | | 5 | 1 | 31 |
| PADZZ | 5961-00-8920734 | SEMICONDUCTOR DEVICE,DIODE TYPE 1N4838... JAN1N4838 (81349) | EA | 1 | | | | * | * | * | | * | 1 | 33 |
| PADZZ | 5961-00-8405316 | TRANSISTOR TYPE 2N3703.....<br>2N3703 (01295) | EA | 1 | | | | | | | | * | 1 | 35 |
| PADZZ | 5961-00-4190165 | TRANSISTOR.....<br>FD1070 (22229) | EA | 15 | * | * | * | * | * | * | | * | 1 | 37 |

AMC FORM 1754 16 APR 70 (ITEA)

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PADZZ | 5961-00-2265968 | TRANSISTOR.....<br>2N3711 (01295) | EA | 1 | | | | | | | | 60 | 1 | 39 |
| PADZZ | 5961-00-2313747 | TRANSISTOR.....<br>MM2005-2 (04713) | EA | 15 | * | * | * | * | * | * | | * | 1 | 41 |
| PAHZZ | 5961-00-0874138 | TRANSISTOR.....<br>2N3708 (80131) | EA | 2 | | | | * | * | * | | * | 1 | 43 |
| PADZZ | 5961-00-0540046 | TRANSISTOR SILICON,HERMETICALLY SEALED,..<br>0.37 DIA,0.26 LG,W/3 WIRE LEAD TYPE TERM.<br>JAN2N1711 (81349) | EA | 1 | | | | | | | | * | 1 | 45 |
| PAFDL | 4931-00-4506700 | BUFFER AMPLIFIER BOARD.....<br>15-031 (24862)<br>CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 2 | 3 |
| PADZZ | 5910-00-6788157 | CAPACITOR,FIXED,CERAMIC DIELECTRIC.....<br>DD101 (71590) | EA | 1 | | | | | | | | 10 | 2 | 5 |
| PADZZ | 5910-00-8820091 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 100 V.<br>DC,10,000 UUF (+- 20 0/0)<br>WMF1S1 (14655) | EA | REF | | | | | | | | * | 2 | 7 |
| PADZZ | 5905-00-1048368 | RESISTOR,FIXED,COMPOSITION 1/4 W,47 OHMS,<br>TYPE RCR07G470JS (+- 5 0/0)<br>RCR07G470JS (81349) | EA | 15 | | | | | | | | 15 | 2 | 9 |
| PADZZ | 5905-00-1057764 | RESISTOR,FIXED,COMPOSITION 1/4 W,2,200...<br>OHMS,TYPE RCR07G222JS (+- 5 0/0)<br>RCR07G222JS (81349) | EA | 1 | | | | | | | | 5 | 2 | 11 |
| PAHZZ | 5905-00-1061282 | RESISTOR,FIXED,COMPOSITION 1/2 W,22,000..<br>OHMS,TYPE RCR20G223JS (+- 5 0/0)<br>RCR20G223JS (81349) | EA | 1 | | | | * | * | * | | * | 2 | 13 |
| PADZZ | 5905-00-1069344 | RESISTOR,FIXED,COMPOSITION 1/2 W,100.....<br>OHMS,TYPE RCR20G101JS (+- 5 0/0)<br>RCR20G101JS (81349) | EA | 1 | * | * | * | * | * | * | | * | 2 | 15 |
| PADZZ | 5905-00-1086922 | RESISTOR,FIXED,COMPOSITION 1/2 W,150.....<br>OHMS,TYPE RCR20G151JS (+- 5 0/0)<br>RCR20G151JS (81349) | EA | 1 | | | | | | | | * | 2 | 17 |
| PADZZ | 5905-00-1114743 | RESISTOR,FIXED,COMPOSITION 1/2 W,82 OHMS,<br>TYPE RCR20G820JS (+- 5 0/0)<br>RCR20G820JS (81349) | EA | 1 | | | | | | | | 5 | 2 | 19 |
| PADZZ | 5905-00-1168558 | RESISTOR,FIXED,COMPOSITION 1/2 W,1.5 MEG,<br>TYPE RCR20G155JS (+- 5 0/0)<br>RCR20G155JS (81349) | EA | 1 | | | | | | | | 5 | 2 | 21 |
| PADZZ | 5905-00-1411071 | RESISTOR,FIXED,COMPOSITION 1/2 W,470,000.<br>OHMS,TYPE RCR20G474JS (+- 5 0/0)<br>RCR20G474JS (81349) | EA | 1 | | | | | | | | 5 | 2 | 23 |
| PAHZZ | 5905-00-1319395 | RESISTOR,FIXED,COMPOSITION 1/2 W,130.....<br>OHMS,TYPE RCR20G131JS (+- 5 0/0)<br>RCR20G131JS (81349) | EA | 1 | * | * | * | * | * | * | | * | 2 | 25 |
| PADZZ | 5905-00-4798142 | RESISTOR,FIXED,FILM.....<br>RNR65C1002FS (81349) | EA | 2 | | | | | | | | * | 2 | 27 |
| PADZZ | 5905-00-4798143 | RESISTOR,FIXED,FILM.....<br>RNR65C1003FS (81349) | EA | 1 | | | | | | | | * | 2 | 29 |
| PADZZ | 5930-00-8354777 | SWITCH,ELECTRIC.....<br>SW126 (88869) | EA | 5 | | | | | | | | 15 | 2 | 31 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PADZZ | 5961-00-1045726 | TRANSISTOR..... 2N3605 (80131) | EA | 1 | | | | | | | | * | 2 | 33 |
| PADZZ | 5961-00-1240117 | TRANSISTOR..... 2N4403 (04713) | EA | 1 | | | | | | | | * | 2 | 35 |
| PADZZ | 5961-00-4045537 | TRANSISTOR..... 2N5087 (04713) | EA | 1 | | | | | | | | 10 | 2 | 37 |
| PADZZ | 5961-00-4900234 | TRANSISTOR..... 2N3860 (03508) | EA | 2 | | | | | | | | 20 | 2 | 39 |
| PADZZ | 5961-00-1188433 | TRANSISTOR..... MFP103 (04713) | EA | 1 | | | | | | | | 20 | 2 | 41 |
| PAFZZ | 6150-00-0711180 | CABLE ASSEMBLY,POWER..... 17419S (70903) | EA | 1 | * | * | * | * | * | * | | 2 | 2 | 43 |
| PADZZ | 5910-00-7821634 | CAPACITIOR,FIXED,CERAMIC DIELECTRIC 1,000 V DC,1,200 UUF (+- 10 0/0) 10015417-056 (1E876) | EA | 12 | | | | | | | | * | 2 | 45 |
| PAFDL | 4931-00-4495064 | CIRCUIT CARD ASSEMBLY..... 15-218 (24862) CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 3 | 3 |
| PADZZ | 5910-00-7821634 | CAPACITIOR,FIXED,CERAMIC DIELECTRIC 1,000 V DC,1,200 UUF (+- 10 0/0) 10015417-056 (18876) | EA | REF | | | | | | | | * | 3 | 5 |
| PADZZ | 5910-00-7344457 | CAPACITOR,FIXED ELECTRULYTIC..... BR2-450 (14655) | EA | 1 | | | | | | | | * | 3 | 7 |
| PADZZ | 5910-00-8431604 | CAPACITOR,FIXED,ELECTRONIC..... TPG175T15 (37942) | EA | 1 | | | | | | | | 10 | 3 | 9 |
| PADZZ | 5910-00-8328080 | CAPACITOR,FIXED,MICA DIELECTRIC 500 V DC, 18 UUF,TYPE CM05CD180J03 CM05CD180J03 (81349) | EA | 1 | | | | | | | | 5 | 3 | 11 |
| PADZZ | 5910-00-1108712 | CAPACITOR,FIXED,MICA DIELECTRIC..... DM15-100J (84171) | EA | 1 | | | | | | | | 5 | 3 | 13 |
| PADZZ | 5960-00-8800457 | ELECTRON TUBE TYPE 6DJ8..... 6DJ8 (81349) | EA | 2 | * | * | * | * | * | * | | * | 3 | 15 |
| PADZZ | 5945-00-9430039 | RELAY,RESONANT REED SPST,12 V DC..... MRR1A (78290) | EA | 2 | * | * | * | * | * | * | | * | 3 | 17 |
| PADZZ | 5905-00-1100196 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,000... OHMS,TYPE RCR20G102JS (+- 5 0/0) RCR20G102JS (81349) | EA | 1 | | | | | | | | * | 3 | 19 |
| PADZZ | 5905-00-1048339 | RESISTOR,FIXED,COMPOSITION 1/2 W,820,000. OHMS,TYPE RCR20G824JS (+- 5 0/0) RCR20G824JS (81349) | EA | 2 | | | | | | | | 10 | 3 | 21 |
| PADZZ | 5905-00-4720155 | RESISTOR,FIXED,FILM..... RNR65C7502FS (81349) | EA | 2 | | | | | | | | 10 | 3 | 23 |
| PADZZ | 5905-00-2422290 | RESISTOR,FIXED,FILM..... RNR65C1503FS (81349) | EA | 2 | | | | | | | | * | 3 | 25 |
| PADZZ | 5961-00-4979136 | TRANSISTOR..... 2N4889 (07263) | EA | 3 | * | * | * | * | * | * | | * | 3 | 27 |
| PADZZ | 5961-00-9310152 | TRANSISTOR TYPE 2N3391..... 2N3391 (80131) | EA | 2 | | | | | | | | 30 | 3 | 29 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAFDL | 6625-00-4418759 | MAIN AVC MODULE BOARD..... M405 (88865) CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 4 | 3 |
| PADZZ | 5910-00-8820C91 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 100 V. DC,10,000 UUF (+- 20 0/0) WMF1S1 (14655) | EA | REF | | | | | | | | * | 4 | 5 |
| PADZZ | 5905-00-4356374 | RESISTOR,FIXED,COMPOSITION 1/4 W,82,000.. OHMS,TYPE RCR07G823JS (+- 5 0/0) RCR07G823JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 7 |
| PADZZ | 5905-00-3696916 | RESISTOR,FIXED,COMPOSITION 1 W,1,200..... OHMS,TYPE RCR32G122JS RCR32G122JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 9 |
| PADZZ | 5905-00-2285506 | RESISTOR,FIXED,COMPOSITION 1/4 W,6,200... OHMS,TYPE RCR07G622JS (+- 5 0/0) RCR07G622JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 11 |
| PADZZ | 5905-00-1411168 | RESISTOR,FIXED,COMPOSITION 1/2 W,2,200... OHMS,TYPE RCR20G222JS (+- 5 0/0) RCR20G222JS (81349) | EA | 1 | | | | | | | | * | 4 | 13 |
| PADZZ | 5905-00-1410744 | RESISTOR,FIXED,COMPOSITION 1/4 W,5,600... OHMS,TYPE RCR07G562JS (+- 5 0/0) RCR07G562JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 15 |
| PADZZ | 5905-00-1410593 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,800... OHMS,TYPE RCR20G182JS (+- 5 0/0) RCR20G182JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 17 |
| PADZZ | 5905-00-1356046 | RESISTOR,FIXED,COMPOSITION 1/4 W,680..... OHMS,TYPE RCR07G681JS (+- 5 0/0) RCR07G681JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 19 |
| PADZZ | 5905-00-1353973 | RESISTOR,FIXED,COMPOSITION 1/4 W,220..... OHMS,TYPE RCR07G221JS (+- 5 0/0) RCR07G221JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 21 |
| PADZZ | 5905-00-1266683 | RESISTOR,FIXED,COMPOSITION 1/4 W,3,300... OHMS,TYPE RCR07G332JS (+- 5 0/0) RCR07G332JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 23 |
| PADZZ | 5905-00-1219932 | RESISTOR,FIXED,COMPOSITION 1/4 W,390..... OHMS,TYPE RCR07G391JS (+- 5 0/0) RCR07G391JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 25 |
| PADZZ | 5905-00-1198855 | RESISTOR,FIXED,COMPOSITION 1/4 W,1,100... OHMS,TYPE RCR07G112JS (+- 5 0/0 RCR07G112JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 27 |
| PADZZ | 5905-00-1193504 | RESISTOR,FIXED,COMPOSITION 1/4 W,27,000.. OHMS,TYPE RCR07G273JS (+- 5 0/0) RCR07G273JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 29 |
| PADZZ | 5905-00-1168556 | RESISTOR,FIXED,COMPOSITION 1/4 W,22,000.. OHMS,TYPE RCR07G223JS (+- 5 0/0) RCR07G223JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 31 |
| PADZZ | 5905-00-1168555 | RESISTOR,FIXED,COMPOSITION 1/4 W,15,000.. OHMS,TYPE RCR07G153JS (+- 5 0/0) RCR07G153JS (81349) | EA | 1 | | | | | | | | * | 4 | 33 |
| PADZZ | 5905-00-1145343 | RESISTOR,FIXED,COMPOSITION 1/4 W,1,800... OHMS,TYPE RCR07G182JS (+- 5 0/0) RCR07G182JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 35 |
| PADZZ | 5905-00-1140711 | RESISTOR,FIXED,COMPOSITION 1/4 W,4,700... OHMS,TYPE RCR07G472JS (+- 5 0/0) RCR07G472JS (81349) | EA | 5 | | | | | | | | 25 | 4 | 37 |
| PADZZ | 5905-00-1114727 | RESISTOR,FIXED,COMPOSITION 1/4 W,2,700... OHMS,TYPE RCR07G272JS (+- 5 0/0) RCR07G272JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 39 |

AVC FORM 1734 10 APR 70 (TEST)



DS, GS, AND DEPOT MAINT ALLOW PER 100 EQUIP

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO | (b) ITEM NO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PADZZ | 5905-00-1111679 | RESISTOR,FIXED,COMPOSITION 1/4 W,5,100... OHMS,TYPE RCR07G512JS (+- 5 0/0) RCR07G512JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 41 |
| PADZZ | 5905-00-1107620 | RESISTOR,FIXED,COMPOSITION 1/4 W,1,000... OHMS,TYPE RCR07G102JS (+- 5 0/0) RCR07G102JS (81349) | EA | 4 | | | | | | | | * | 4 | 43 |
| PADZZ | 5905-00-1100196 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,000... OHMS,TYPE RCR20G102JS (+- 5 0/0) RCR20G102JS (81349) | EA | REF | | | | | | | | * | 4 | 45 |
| PADZZ | 5905-00-1069356 | RESISTOR,FIXED,COMPOSITION 1/4 W,20,000.. OHMS,TYPE RCR07G203JS (+- 5 0/0) RCR07G203JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 47 |
| PADZZ | 5905-00-1069348 | RESISTOR,FIXED,COMPOSITION 1/2 W,150,000. OHMS,TYPE RCR20G154JS (+- 5 0/0) RCR20G154JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 49 |
| PADZZ | 5905-00-1069345 | RESISTOR,FIXED,COMPOSITION 1/2 W,68,000.. OHMS,TYPE RCR20G683JS (+- 5 0/0) RCR20G683JS (81349) | EA | 1 | | | | | | | | * | 4 | 51 |
| PADZZ | 5905-00-1063668 | RESISTOR,FIXED,COMPOSITION 1/4 W,22 OHMS, TYPE RCR07G220JS (+- 5 0/0) RCR07G220JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 53 |
| PADZZ | 5905-00-1061356 | RESISTOR,FIXED,COMPOSITION 1/4 W,1,500... OHMS,TYPE RCR07G152JS (+ - 5 0/0) RCR07G152JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 55 |
| PADZZ | 5905-00-1061278 | RESISTOR,FIXED,COMPOSITION 1/4 W,12,000.. OHMS,TYPE RCR07G123JS (+- 5 0/0) RCR07G123JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 57 |
| PADZZ | 5905-00-1057768 | RESISTOR,FIXED,COMPOSITION 1/4 W,560..... OHMS,TYPE RCR07G561JS (+- 5 0/0) RCR07G561JS (81349) | EA | 1 | | | | | | | | 4 | 4 | 59 |
| PADZZ | 5905-00-1057765 | RESISTOR,FIXED,COMPOSITION 1/4 W,220,000. OHMS,TYPE RCR07G224JS (+- 5 0/0) RCR07G224JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 61 |
| PADZZ | 5905-00-1048358 | RESISTOR,FIXED,COMPOSITION 1/4 W,8,200... OHMS,TYPE RCR07G822JS (+- 5 0/0) RCR07G822JS (81349) | EA | 1 | | | | | | | | 5 | 4 | 63 |
| PAHZZ | 5961-00-8920734 | SEMICONDUCTOR DEVICE,DIODE TYPE 1N4838... JAN1N4838 (81349) | EA | REF | | | | * | * | * | | * | 4 | 65 |
| PADZZ | 5961-00-9305326 | TRANSISTOR..... 2N3702 (01295) | EA | 3 | | | | | | | | * | 4 | 67 |
| PADZZ | 5961-00-8405316 | TRANSISTOR TYPE 2N3703..... 2N3703 (01295) | EA | REF | | | | | | | | * | 4 | 69 |
| PADZZ | 5961-00-0874138 | TRANSISTOR..... 2N3708 (80131) | EA | REF | | | | | | | | * | 4 | 71 |
| PAFZZ | 4931-00-4924362 | METER..... 18-001 (24862) | EA | 1 | * | * | * | * | * | * | | 7 | 4 | 73 |
| PAFDL | 4931-00-4418757 | METERING OVERLOAD BOARD ASSEMBLY..... 15-222 (24862) | EA | 1 | * | * | * | * | * | * | | 7 | 5 | 3 |
| | | CONSISTING OF | | | | | | | | | | | | |
| PADZZ | 5905-00-1048348 | RESISTOR,FIXED,COMPOSITION 1/2 W,3,300... OHMS,TYPE RCR20G332JS (+- 5 0/0) RCR20G332JS (81349) | EA | 1 | | | | | | | | * | 5 | 5 |
| PADZZ | 5905-00-1319395 | RESISTOR,FIXED,COMPOSITION 1/2 W,130..... CONTINUED | EA | REF | | | | | | | | * | 5 | 7 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION<br>REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTINUED<br>OHMS,TYPE RCR20G131JS (+- 5 0/0)<br>RCR20G131JS (81349) | | | | | | | | | | | | |
| PADZZ | 5905-00-1219923 | RESISTOR,FIXED,COMPOSITION 1/2 W,6.8 MEG,<br>TYPE RCR20G685JS (+- 5 0/0)<br>RCR20G685JS (81349) | EA | 10 | | | | | | | | 10 | 5 | 9 |
| PADZZ | 5905-00-6570045 | RESISTOR,FIXED,FILM.....<br>RNR65C1401FS (81349) | EA | 1 | | | | | | | | 5 | 5 | 11 |
| PADZZ | 5905-00-1411168 | RESISTOR,FIXED,COMPOSITION 1/2 W,2,200...<br>OHMS,TYPE RCR20G222JS (+- 5 0/0)<br>RCR20G222JS (81349) | EA | REF | | | | | | | | * | 5 | 13 |
| PADZZ | 5905-00-1411165 | RESISTOR,FIXED,COMPOSITION 1/2 W,6,800...<br>OHMS,TYPE RCR20G682JS (+- 5 0/0)<br>RCR20G682JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 15 |
| PADZZ | 5905-00-1411130 | RESISTOR,FIXED,COMPOSITION 1/2 W,2,700...<br>OHMS,TYPE RCR20G272JS (+- 5 0/0)<br>RCR20G272JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 17 |
| PADZZ | 5905-00-1410595 | RESISTOR,FIXED,COMPOSITION 1/2 W,4,700...<br>OHMS,TYPE RCR20G472JS (+- 5 0/0)<br>RCR20G472JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 19 |
| PADZZ | 5905-00-1410592 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,200...<br>OHMS,TYPE RCR20G122JS (+- 5 0/0)<br>RCR20G122JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 21 |
| PADZZ | 5905-00-1168569 | RESISTOR,FIXED,COMPOSITION 1/2 W,820.....<br>OHMS,TYPE RCR20G821JS (+- 5 0/0)<br>RCR20G821JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 23 |
| PADZZ | 5905-00-1114734 | RESISTOR,FIXED,COMPOSITION 1/2 W,47 OHMS,<br>TYPE RCR20G470JS (+- 5 0/0)<br>RCR20G470JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 25 |
| PADZZ | 5905-00-1069347 | RESISTOR,FIXED,COMPOSITION 1/2 W,3.3 MEG,<br>TYPE RCR20G335JS (+- 5 0/0)<br>RCR20G335JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 27 |
| PAFZZ | 5945-00-9430039 | RELAY,RESONANT REED SPST,12 V DC.....<br>MRR1A (78290) | EA | REF | * | * | * | * | * | * | | * | 5 | 29 |
| PADZZ | 5905-00-1048336 | RESISTOR,FIXED,COMPOSITION 1/2 W,100,000.<br>OHMS,TYPE RCR20G104JS (+- 5 0/0)<br>RCR20G104JS (81349) | EA | 1 | | | | | | | | 4 | 5 | 31 |
| PAFZZ | 5905-00-1266691 | RESISTOR,FIXED,COMPOSITION 1/2 W,15 OHMS,<br>TYPE RCR20G150JS (+- 10 0/0)<br>RCR20G150JS (81349) | EA | 1 | * | * | * | * | * | * | | * | 5 | 33 |
| PAFZZ | 5905-00-1411118 | RESISTOR,FIXED,COMPOSITION 1/2 W,39 OHMS,<br>TYPE RCR20G390JS (+- 5 0/0)<br>RCR20G390JS (81349) | EA | 1 | * | * | * | * | * | * | | * | 5 | 35 |
| PADZZ | 5905-00-4798143 | RESISTOR,FIXED,FILM.....<br>RNR65C1003FS (81349) | EA | REF | | | | | | | | * | 5 | 37 |
| PADZZ | 5905-00-4798142 | RESISTOR,FIXED,FILM.....<br>RNR65C1002FS (81349) | EA | REF | | | | | | | | * | 5 | 39 |
| PAFZZ | 5905-00-1069344 | RESISTOR,FIXED,COMPOSITION 1/2 W,100.....<br>OHMS,TYPE RCR20G101JS (+- 5 0/0)<br>RCR20G101JS (81349) | EA | REF | * | * | * | * | * | * | | * | 5 | 41 |
| PAFZZ | 5905-00-1319395 | RESISTOR,FIXED,COMPOSITION 1/2 W,130.....<br>OHMS,TYPE RCR20G131JS (+- 5 0/0)<br>RCR20G131JS (81349) | EA | REF | * | * | * | * | * | * | | * | 5 | 43 |
| PADZZ | 5961-00-9305326 | TRANSISTOR.....<br>2N3702 (01295) | EA | REF | | | | | | | | * | 5 | 45 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION<br>REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAFDH | 4931-00-4418750 | POWER SUPPLY BOARD AND ASSEMBLY.....<br>15-221 (24862)<br>CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 6 | 3 |
| PADZZ | 5910-00-7344457 | CAPACITOR,FIXED ELECTROLYTIC.....<br>BR2-450 (14655) | EA | REF | | | | | | | | * | 6 | 5 |
| PADZZ | 5910-00-8820091 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 100 V.<br>DC,10,000 UUF (+- 20 0/0)<br>WMF1S1 (14655) | EA | REF | | | | | | | | * | 6 | 7 |
| PADZZ | 5905-00-1086922 | RESISTOR,FIXED,COMPOSITION 1/2 W,150.....<br>OHMS,TYPE RCR20G151JS (+- 5 0/0)<br>RCR20G151JS (81349) | EA | REF | | | | | | | | * | 6 | 9 |
| PADZZ | 5905-00-1145456 | RESISTOR,FIXED,COMPOSITION 1/2 W,680,000.<br>OHMS,TYPE RCR20G684JS (+- 5 0/0)<br>RCR20G684JS (81349) | EA | 1 | * | * | * | * | * | * | | * | 6 | 11 |
| PADZZ | 5905-00-1045755 | RESISTOR,FIXED,COMPOSITION 1/2 W,10 OHMS,<br>TYPE RCR20G100JS (+- 5 0/0)<br>RCR20G100JS (81349) | EA | REF | | | | | | | | * | 6 | 13 |
| PADZZ | 5905-00-1114738 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,500...<br>OHMS,TYPE RCR20G152JS (+- 5 0/0)<br>RCR20G152JS (81349) | EA | 1 | | | | | | | | * | 6 | 15 |
| PADZZ | 5905-00-1411168 | RESISTOR,FIXED,COMPOSITION 1/2 W,2,200...<br>OHMS,TYPE RCR20G222JS (+- 5 0/0)<br>RCR20G222JS (81349) | EA | REF | | | | | | | | * | 6 | 17 |
| PAFZZ | 5961-00-2313747 | TRANSISTOR.....<br>MM2005-2 (04713) | EA | REF | * | * | * | * | * | * | | * | 6 | 19 |
| PADZZ | 5961-00-1045726 | TRANSISTOR.....<br>2N3605 (80131) | EA | REF | | | | | | | | * | 6 | 21 |
| PADZZ | 5961-00-1240117 | TRANSISTOR.....<br>2N4403 (04713) | EA | REF | | | | | | | | * | 6 | 23 |
| PADZZ | 5905-00-1410598 | RESISTOR,FIXED,COMPOSITION 1/2 W,560.....<br>OHMS,TYPE RCR20G561JS (+- 5 0/0)<br>RCR20G561JS (81349) | EA | 1 | | | | | | | | 5 | 6 | 25 |
| PADZZ | 5905-00-1266691 | RESISTOR,FIXED,COMPOSITION 1/2 W,15 OHMS,<br>TYPE RCR20G150JS (+- 10 0/0)<br>RCR20G150JS (81349) | EA | REF | | | | | | | | * | 6 | 27 |
| PADZZ | 5905-00-2422290 | RESISTOR,FIXED,FILM.....<br>RNR65C1503FS (81349) | EA | REF | | | | | | | | * | 6 | 29 |
| PADZZ | 5961-00-1114795 | SEMICONDUCTOR DEVICE,DIODE.....<br>1N5061 (03508) | EA | 6 | * | * | * | * | * | * | | * | 6 | 31 |
| PADZZ | 5961-00-9252109 | TRANSISTOR.....<br>2N3392 (03508) | EA | 4 | | | | | | | | 60 | 6 | 33 |
| PADZZ | 5961-00-4154632 | TRANSISTOR.....<br>MPF151 (04713) | EA | 2 | * | * | * | * | * | * | | * | 6 | 35 |
| PAFDL | 6625-00-4506699 | POWER SUPPLY MODULE BOARD.....<br>M401 (88865)<br>CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 7 | 3 |
| PADZZ | 5910-00-8935179 | CAPACITOR,FIXED,ELECTROLYTIC 50 V DC,20..<br>UF<br>11065337-004 (18876) | EA | 1 | | | | | | | | 5 | 7 | 5 |
| PADZZ | 5905-00-9358545 | RESISTOR,FIXED,COMPOSITION 1/2 W,18,000..<br>CONTINUED | EA | REF | | | | | | | | * | 7 | 7 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTINUED<br>OHMS,TYPE RCR20G183JS (+- 5 0/0)<br>RCR20G183JS (81349) | | | | | | | | | | | | |
| PADZZ | 5905-00-1145361 | RESISTOR,FIXED,COMPOSITION 1/2 W,120.....<br>OHMS,TYPE RCR20G121JS (+- 5 0/0)<br>RCR20G121JS (81349) | EA | 1 | | | | | | | | 5 | 7 | 9 |
| PADZZ | 5905-00-1114738 | RESISTOR,FIXED,COMPOSITION 1/2 W,1,500...<br>OHMS,TYPE RCR20G152JS (+- 5 0/0)<br>RCR20G152JS (81349) | EA | REF | | | | | | | | * | 7 | 11 |
| PADZZ | 5905-00-1100993 | RESISTOR,FIXED,COMPOSITION 1/2 W,12,000..<br>OHMS,TYPE RCR20G123JS (+- 5 0/0)<br>RCR20G123JS (81349) | EA | 1 | | | | | | | | 5 | 7 | 13 |
| PAFZZ | 5905-00-1061273 | RESISTOR,FIXED,COMPOSITION 1/2 W,15,000..<br>OHMS,TYPE RCR20G153JS (+- 5 0/0)<br>RCR20G153JS (81349) | EA | 1 | * | * | * | * | * | * | | 5 | 7 | 15 |
| PADZZ | 5905-00-1048349 | RESISTOR,FIXED,COMPOSITION 1/2 W,510.....<br>OHMS,TYPE RCR20G511JS (+- 5 0/0)<br>RCR20G511JS (81349) | EA | 1 | | | | | | | | 5 | 7 | 17 |
| PAFDL | 6625-00-4418761 | REFERENCE AVC MODULE.....<br>M406 (88865)<br>CONSISTING OF | EA | 1 | * | * | * | * | * | * | | 7 | 8 | 3 |
| PADZZ | 5910-00-8352710 | CAPACITOR,FIXED,PLASTIC DIELECTRIC 50 V..<br>DC,10,000 UUF,TYPE CTM103VAJ<br>CTM103VAJ (81349) | EA | REF | | | | | | | | * | 8 | 5 |
| PAHZZ | 5910-00-7265003 | CAPACITOR,FIXED,ELECTROLYTIC.....<br>150D105X0035A2 (56289) | EA | REF | | | | * | * | * | | * | 8 | 7 |
| PAHZZ | 5905-00-1114744 | RESISTOR,FIXED,COMPOSITION 1/2 W,5,100...<br>OHMS,TYPE RCR20G512JS (+- 5 0/0)<br>RCR20G512JS (81349) | EA | 1 | | | | * | * | * | | 5 | 8 | 9 |
| PADZZ | 5905-00-1111681 | RESISTOR,FIXED,COMPOSITION 1/4 W,130,000.<br>OHMS,TYPE RCR07G134JS (+- 5 0/0)<br>RCR07G134JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 11 |
| PADZZ | 5905-00-1107622 | RESISTOR,FIXED,COMPOSITION 1/4 W,6,800...<br>OHMS,TYPE RCR07G682JS (+- 5 0/0)<br>RCR07G682JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 13 |
| PADZZ | 5905-00-1107620 | RESISTOR,FIXED,COMPOSITION 1/4 W,1,000...<br>OHMS,TYPE RCR07G102JS (+- 5 0/0)<br>RCR07G102JS (81349) | EA | REF | | | | | | | | * | 8 | 15 |
| PADZZ | 5905-00-1100388 | RESISTOR,FIXED,COMPOSITION 1/4 W,100,000.<br>OHMS,TYPE RCR07G104JS (+- 5 0/0)<br>RCR07G104JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 17 |
| PADZZ | 5905-00-1061282 | RESISTOR,FIXED,COMPOSITION 1/2 W,22,000..<br>OHMS,TYPE RCR20G223JS (+- 5 0/0)<br>RCR20G223JS (81349) | EA | REF | | | | | | | | * | 8 | 19 |
| PAHZZ | 5905-00-1061247 | RESISTOR,FIXED,COMPOSITION 1 W,220 OHMS,..<br>TYPE RCR32G221JS<br>RCR32G221JS (81349) | EA | 1 | | | | * | * | * | | 5 | 8 | 21 |
| PADZZ | 5905-00-1193505 | RESISTOR,FIXED,COMPOSITION 1/4 W,68,000..<br>OHMS,TYPE RCR07G683JS (+- 5 0/0)<br>RCR07G683JS (81349) | EA | 1 | | | | | | | | 10 | 8 | 23 |
| PADZZ | 5905-00-1168568 | RESISTOR,FIXED,COMPOSITION 1/2 W,7,500...<br>OHMS,TYPE RCR20G752JS (+- 5 0/0)<br>RCR20G752JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 25 |
| PAHZZ | 5905-00-1168567 | RESISTOR,FIXED,COMPOSITION 1/2 W,75 OHMS,<br>CONTINUED | EA | 1 | | | | * | * | * | | 5 | 8 | 27 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTINUED<br>TYPE RCR20G750JS (+- 5 0/0)<br>RCR20G750JS (81349) | | | | | | | | | | | | |
| PADZZ | 5905-00-1168555 | RESISTOR,FIXED,COMPOSITION 1/4 W,15,000..<br>OHMS,TYPE RCR07G153JS (+- 5 0/0)<br>RCR07G153JS (81349) | EA | REF | | | | | | | | * | 8 | 29 |
| PADZZ | 5905-00-1153565 | RESISTOR,FIXED,COMPOSITION 1 W,820 OHMS,..<br>TYPE RCR32G821JS (+- 5 0/0)<br>RCR32G821JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 31 |
| PADZZ | 5905-00-1140710 | RESISTOR,FIXED,COMPOSITION 1/4 W,330.....<br>OHMS,TYPE RCR07G331JS (+- 5 0/0)<br>RCR07G331JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 33 |
| PAHZZ | 5905-00-2446934 | RESISTOR,FIXED,COMPOSITION 1/4 W,820,000.<br>OHMS,TYPE RCR07G824JS<br>RCR07G824JS (81349) | EA | 1 | | | | * | * | * | | 5 | 8 | 35 |
| PADZZ | 5905-00-1411116 | RESISTOR,FIXED,COMPOSITION 1/2 W,5,600...<br>OHMS,TYPE RCR20G562JS (+ - 5 0/0)<br>RCR20G562JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 37 |
| PADZZ | 5905-00-9122279 | RESISTOR,FIXED,WIRE WOUND 1 W,196 OHMS...<br>(+- 3 0/0)<br>10015620-207 (18876) | EA | 1 | | | | | | | | 5 | 8 | 39 |
| PADZZ | 5905-00-1410600 | RESISTOR,FIXED,COMPOSITION 1/2 W,8,200...<br>OHMS,TYPE RCR20G822JS (+- 5 0/0)<br>RCR20G822JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 41 |
| PADZZ | 5905-00-1114746 | RESISTOR,FIXED,COMPOSITION 1/2 W,16,000..<br>OHMS,TYPE RCR20G163JS (+- 5 0/0)<br>RCR20G163JS (81349) | EA | 1 | | | | | | | | 5 | 8 | 43 |
| PAHZZ | 5905-00-1048342 | RESISTOR,FIXED,COMPOSITION 1/2 W,4,300...<br>OHMS,TYPE RCR20G432JS (+- 5 0/0)<br>RCR20G432JS (81349) | EA | 1 | | | | * | * | * | | 5 | 8 | 45 |
| PADZZ | 5905-00-1048348 | RESISTOR,FIXED,COMPOSITION 1/2 W,3,300...<br>OHMS,TYPE RCR20G332JS (+- 5 0/0)<br>RCR20G332JS (81349) | EA | REF | | | | | | | | * | 8 | 47 |
| PADZZ | 5961-00-8920734 | SEMICONDUCTOR DEVICE,DIODE TYPE 1N4838...<br>JAN1N4838 (81349) | EA | REF | | | | | | | | * | 8 | 49 |
| PADZZ | 5961-00-4223466 | TRANSISTOR.....<br>2N412H (04713) | EA | 1 | | | | | | | | 30 | 8 | 51 |
| PADZZ | 5961-00-9270845 | TRANSISTOR.....<br>2N3640 (07263) | EA | 1 | | | | | | | | 15 | 8 | 55 |
| PADZZ | 5961-00-4190167 | TRANSISTOR.....<br>F1088A (22229) | EA | 1 | * | * | * | * | * | * | | 7 | 8 | 57 |
| | | MAIN FRAME ASSEMBLY<br>CONSISTING OF | | | | | | | | | | | | |
| PAFZZ | 5935-00-5205005 | CONNECTOR,RECEPTABLE,ELECTRICAL.....<br>RP25GB (58474) | EA | 7 | * | * | * | * | * | * | | 14 | 9 | 3 |
| PAFZZ | 5960-00-8800457 | ELECTRON TUBE TYPE 6DJ8.....<br>6DJ8 (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 5 |
| PAHZZ | 4931-00-4605973 | FAN.....<br>RF147 (82877) | EA | 1 | | | | * | * | * | | 3 | 9 | 7 |
| PAFZZ | 5920-00-5778487 | FUSE,CARTRIDGE.....<br>88S2 (71400) | EA | 1 | * | * | * | * | * | * | | 5 | 9 | 9 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PAFZZ | 5920-00-6884085 | FUSE,CARTRIDGE 10 AMP,250 V,0.406 DIA,1.5 LG<br>F09B250V10A (81349) | EA | 1 | * | * | * | * | * | * | | * | 9 | 11 |
| PAFZZ | 5920-00-2358358 | FUSE,CARTRIDGE 1/4 AMP,250 V AC AND DC,.. 1/4 DIA,1 LG,TYPE F01A250V1-4A<br>F01A250V1-4A (81349) | EA | 1 | * | * | * | * | * | * | | * | 9 | 13 |
| PAFZZ | | | | | | | | | | | | | | |
| PAFZZ | 5935-00-9136260 | JACK,TIP.....<br>RS25GR (58474) | EA | 7 | * | * | * | * | * | * | | 21 | 9 | 19 |
| PAFZZ | 5935-00-7620312 | JACK,TIP.....<br>M39024-10-03 (81349) | EA | 1 | * | * | * | * | * | * | | 3 | 9 | 21 |
| PAFZZ | 5935-00-7024199 | JACK,TIP.....<br>M39024-10-02 (81349) | EA | 2 | * | * | * | * | * | * | | 6 | 9 | 23 |
| PAFZZ | 6210-00-0772507 | LIGHT,INDICATOR.....<br>8G03RCSNE2H033K (03797) | EA | 1 | * | * | * | * | * | * | | 7 | 9 | 25 |
| PADZZ | 5905-00-1069345 | RESISTOR,FIXED,COMPOSITION 1/2 W,68,000.. OHMS,TYPE RCR20G683JS (+- 5 0/0)<br>RCR20G683JS (81349) | EA | REF | | | | | | | | * | 9 | 27 |
| PAFZZ | 5905-00-1145456 | RESISTOR,FIXED,COMPOSITION 1/2 W,680,000. OHMS,TYPE RCR20G684JS (+- 5 0/0)<br>RCR20G684JS (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 29 |
| PAFZZ | 5905-00-1411118 | RESISTOR,FIXED,COMPOSITION 1/2 W,39 OHMS, TYPE RCR20G390JS (+- 5 0/0)<br>RCR20G390JS (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 31 |
| PAFZZ | 5905-00-1319395 | RESISTOR,FIXED,COMPOSITION 1/2 W,130..... OHMS,TYPE RCR20G131JS (+- 5 0/0)<br>RCR20G131JS (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 33 |
| PAFZZ | 5905-00-1266691 | RESISTOR,FIXED,COMPOSITION 1/2 W,15 OHMS, TYPE RCR20G150JS (+- 10 0/0)<br>RCR20G150JS (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 35 |
| PAFZZ | 5905-00-1069344 | RESISTOR,FIXED,COMPOSITION 1/2 W,100..... OHMS,TYPE RCR20G101JS (+- 5 0/0)<br>RCR20G101JS (81349) | EA | REF | * | * | * | * | * | * | | * | 9 | 37 |
| PAFZZ | 5905-00-1048350 | RESISTOR,FIXED,COMPOSITION 1/2 W,220..... OHMS,TYPE RCR20GF221JS (+- 5 0/0)<br>RCR20G221JS (81349) | EA | 2 | * | * | * | * | * | * | | 5 | 9 | 39 |
| PAFZZ | 5905-00-1003407 | RESISTOR,FIXED,WIRE WOUND 25 W,1 OHM (+-. 5 0/0)<br>9163050 (18876) | EA | 1 | * | * | * | * | * | * | | 5 | 9 | 41 |
| PAFZZ | 5905-00-2834767 | RESISTOR,FIXED,WIRE WOUND.....<br>0217 (44655) | EA | 1 | * | * | * | * | * | * | | 10 | 9 | 43 |
| PAFZZ | 5905-00-5525478 | RESISTOR,VARIABLE COMPOSITION ELEMENT,2.. W,1,000 OHMS,TYPE RV4NAYSD102A (+- 10 0/0)<br>RV4NAYSD102A (81349) | EA | 1 | * | * | * | * | * | * | | 10 | 9 | 45 |
| PAFZZ | 5945-00-2436403 | RELAY,ARMATURE.....<br>KAP11AG120V (77342) | EA | 1 | * | * | * | * | * | * | | 7 | 9 | 47 |
| PAFZZ | 5961-00-1114795 | SEMICONDUCTOR DEVICE,DIODE.....<br>1N5061 (03508) | EA | REF | * | * | * | * | * | * | | * | 9 | 49 |
| PAFZZ | 5930-00-6816699 | SWITCH,ROTARY.....<br>PA1007 (71590) | EA | 1 | * | * | * | * | * | * | | 3 | 9 | 51 |
| PAFZZ | 5930-00-6551508 | SWITCH,TOGGLE DPDT,5 AMP,115 V AC,125 V.. CONTINUED | EA | 2 | * | * | * | * | * | * | | 4 | 9 | 53 |

| (1) SMR CODE | (2) NATIONAL STOCK NUMBER | (3) DESCRIPTION REFERENCE NUMBER & MFR. CODE USABLE ON CODE | (4) UNIT OF MEAS | (5) QTY INC IN UNIT | (6) 30-DAY DS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (7) 30-DAY GS MAINT ALLOWANCE (a) 1-20 | (b) 21-50 | (c) 51-100 | (8) 1-YR ALW PER 100 EQUIP CNTGCY | (9) DEPOT MAINT ALW PER 100 EQUIP | (10) ILLUSTRATION (a) FIGURE NO. | (b) ITEM NO. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CONTINUED<br>DC,BAT TYPE ACTUATOR,23/32 W,23/32 DEEP,1-9/32 LG,W/6 SOLDER LUG TYPE TERM.<br>MS25100-23 (96906) | | | | | | | | | | | | |
| PAFZZ | 5950-00-4213056 | TRANSFORMER,POWER,STEP-UP.....<br>01-427A (24862) | EA | 1 | * | * | * | * | * | * | | 1 | 9 | 55 |
| PAHZZ | 5950-00-7352686 | TRANSFORMER,AUTO STEP-UP.....<br>01-426 (24862) | EA | 1 | | | | * | * | * | | 5 | 9 | 57 |
| PAFZZ | 5961-00-4979136 | TRANSISTOR.....<br>2N4889 (07263) | EA | REF | * | * | * | * | * | * | | * | 9 | 59 |
| PAFZZ | 5961-00-4190165 | TRANSISTOR.....<br>FD1070 (22229) | EA | REF | * | * | * | * | * | * | | * | 9 | 61 |
| PAFZZ | 5961-00-4190167 | TRANSISTOR.....<br>F1088A (22229) | EA | 1 | * | * | * | * | * | * | | 7 | 9 | 63 |
| PAFZZ | 5961-00-9479430 | TRANSISTOR.....<br>DTS413 (16758) | EA | 1 | * | * | * | * | * | * | | 10 | 9 | 65 |
| PAFZZ | 5961-00-4154632 | TRANSISTOR.....<br>MPF151 (04713) | EA | REF | * | * | * | * | * | * | | * | 9 | 67 |
| PAFZZ | 5961-00-4433953 | TRANSISTOR NONIDENTICAL,DATED 29 JAN 73,.<br>SEE FSN 5961-085-0468,REF NO. JAN2N3902 &<br>DTS423 (16758) | EA | 1 | * | * | * | * | * | * | | 10 | 9 | 69 |
| PAFZZ | 4931-00-1598957 | TUBE SET 8 EA.....<br>15-041 (24862) | SE | 8 | * | * | * | * | * | * | | 20 | 9 | 71 |
| PCFZZ | 4931-00-4506700 | CIRCUIT BOARD ASSEMBLY.....<br>15-036 (24862) | EA | 1 | * | * | * | * | * | * | | 10 | 9 | 73 |

## INDEX - NATIONAL STOCK NUMBER AND REFERENCE NUMBER CROSS-REFERENCE TO FIGURE AND ITEM NUMBER

| STOCK NUMBER | FIGURE NO. | ITEM NO. |
|---|---|---|
| 4931-00-1598957 | 9 | 71 |
| 4931-00-4418750 | 6 | 3 |
| 4931-00-4418757 | 5 | 3 |
| 4931-00-4495064 | 3 | 3 |
| 4931-00-4506697 | 1 | 3 |
| 4931-00-4506698 | 1 | 5 |
| 4931-00-4506700 | 2 | 3 |
| 4931-00-4506700 | 9 | 73 |
| 4931-00-4605973 | 9 | 7 |
| 4931-00-4924362 | 4 | 73 |
| 5905-00-1003407 | 9 | 41 |
| 5905-00-1045755 | 1 | 21 |
| 5905-00-1045755 | 6 | 13 |
| 5905-00-1048336 | 5 | 31 |
| 5905-00-1048339 | 3 | 21 |
| 5905-00-1048342 | 8 | 45 |
| 5905-00-1048348 | 5 | 5 |
| 5905-00-1048348 | [illegible] | 47 |
| 5905-00-1048349 | 7 | 17 |
| 5905-00-1048350 | 9 | 39 |
| 5905-00-1048358 | 4 | 63 |
| 5905-00-1048368 | 2 | 9 |
| 5905-00-1057764 | 2 | 11 |
| 5905-00-1057765 | 4 | 61 |
| 5905-00-1057768 | 4 | 59 |
| 5905-00-1061247 | [illegible] | 21 |
| 5905-00-1061273 | 7 | 15 |
| 5905-00-1061278 | 4 | 57 |
| 5905-00-1061282 | 2 | 13 |
| 5905-00-1061282 | [illegible] | 19 |
| 5905-00-1061356 | 4 | 55 |
| 5905-00-1063668 | 4 | 53 |
| 5905-00-1069344 | 2 | 15 |
| 5905-00-1069344 | 5 | 41 |
| 5905-00-1069344 | 9 | 37 |
| 5905-00-1069345 | 4 | 51 |
| 5905-00-1069345 | 9 | 27 |
| 5905-00-1069347 | 5 | 27 |
| 5905-00-1069348 | 4 | 49 |
| 5905-00-1069356 | 4 | 47 |
| 5905-00-1086922 | 2 | 17 |
| 5905-00-1086922 | 6 | 9 |
| 5905-00-1100196 | 3 | 19 |
| 5905-00-1100196 | 4 | 45 |
| 5905-00-1100388 | [illegible] | 17 |
| 5905-00-1100993 | 7 | 13 |
| 5905-00-1107620 | 4 | 43 |
| 5905-00-1107620 | 8 | 15 |
| 5905-00-1107622 | 8 | 13 |
| 5905-00-1111679 | 4 | 41 |
| 5905-00-1111681 | 8 | 11 |
| 5905-00-1114727 | 4 | 39 |
| 5905-00-1114734 | 5 | 25 |
| 5905-00-1114738 | 6 | 15 |
| 5905-00-1114738 | 7 | 11 |
| 5905-00-1114743 | 2 | 19 |
| 5905-00-1114744 | 8 | 9 |
| 5905-00-1114746 | [illegible] | 43 |
| 5905-00-1118357 | [illegible] | 27 |
| 5905-00-1134853 | [illegible] | 25 |
| 5905-00-1140710 | 8 | 33 |
| 5905-00-1140711 | 4 | 37 |
| 5905-00-1145343 | 4 | 35 |
| 5905-00-1145361 | 7 | 9 |
| 5905-00-1145425 | 1 | 19 |
| 5905-00-1145456 | 6 | 11 |
| 5905-00-1145456 | 9 | 29 |
| 5905-00-1153565 | 8 | 31 |
| 5905-00-1168555 | 4 | 33 |
| 5905-00-1168555 | [illegible] | 29 |
| 5905-00-1168556 | 4 | 31 |
| 5905-00-1168558 | 2 | 21 |
| 5905-00-1168567 | 8 | 27 |
| 5905-00-1168568 | 8 | 25 |
| 5905-00-1168569 | 5 | 23 |
| 5905-00-1193504 | 4 | 29 |
| 5905-00-1193505 | 8 | 23 |
| 5905-00-1198855 | 4 | 27 |
| 5905-00-1219923 | 5 | 9 |
| 5905-00-1219932 | [illegible] | 25 |
| 5905-00-1266683 | 4 | 23 |
| 5905-00-1266691 | 5 | 33 |
| 5905-00-1266691 | 6 | 27 |
| 5905-00-1266691 | [illegible] | 35 |
| 5905-00-1319395 | 2 | 25 |
| 5905-00-1319395 | 5 | 7 |
| 5905-00-1319395 | 5 | 43 |
| 5905-00-1319395 | 9 | 33 |
| 5905-00-1353973 | 4 | 21 |
| 5905-00-1356046 | 4 | 19 |
| 5905-00-1410591 | [illegible] | 23 |
| 5905-00-1410592 | 5 | 21 |
| 5905-00-1410593 | 4 | 17 |
| 5905-00-1410595 | 5 | 19 |
| 5905-00-1410598 | [illegible] | 25 |
| 5905-00-1410600 | 8 | 41 |
| 5905-00-1410744 | 4 | 15 |
| 5905-00-1411071 | 2 | 23 |
| 5905-00-1411116 | 8 | 37 |
| 5905-00-1411118 | 5 | 35 |
| 5905-00-1411118 | 9 | 31 |
| 5905-00-1411130 | 5 | 17 |
| 5905-00-1411165 | 5 | 15 |
| 5905-00-1411168 | 4 | 13 |
| 5905-00-1411168 | 5 | 13 |
| 5905-00-1411168 | 6 | 17 |
| 5905-00-2285506 | 4 | 11 |
| 5905-00-2422290 | 3 | 25 |
| 5905-00-2422290 | 6 | 29 |
| 5905-00-2446934 | 8 | 35 |
| 5905-00-2834767 | 9 | 43 |
| 5905-00-3696916 | [illegible] | 9 |
| 5905-00-4356374 | 4 | 7 |
| 5905-00-4720155 | 3 | 23 |
| 5905-00-4798142 | 2 | 27 |
| 5905-00-4798142 | 5 | 39 |
| 5905-00-4798143 | 2 | 29 |
| 5905-00-4798143 | 5 | 37 |
| 5905-00-5525478 | 9 | 45 |
| 5905-00-6570045 | 5 | 11 |
| 5905-00-9122279 | [illegible] | 39 |
| 5905-00-9358539 | 1 | 31 |
| 5905-00-9358545 | [illegible] | 29 |
| 5905-00-9358545 | 7 | 7 |
| 5910-00-1108712 | 3 | 13 |
| 5910-00-6788157 | 2 | 5 |
| 5910-00-7265003 | 1 | 7 |
| 5910-00-7265003 | [illegible] | 7 |
| 5910-00-7344457 | 3 | 7 |
| 5910-00-7344457 | 6 | 5 |
| 5910-00-7821634 | 2 | 45 |
| 5910-00-7821634 | 3 | 5 |
| 5910-00-8328080 | 3 | 11 |
| 5910-00-8352710 | 1 | 11 |
| 5910-00-8352710 | 8 | 5 |
| 5910-00-8431604 | 3 | 9 |
| 5910-00-8820091 | 1 | 15 |
| 5910-00-8820091 | 2 | 7 |
| 5910-00-8820091 | 4 | 5 |
| 5910-00-8820091 | 6 | 7 |
| 5910-00-8935179 | 7 | 5 |
| 5910-00-9574731 | 1 | 13 |
| 5910-00-9578578 | 1 | 9 |
| 5920-00-2358358 | 9 | 13 |
| 5920-00-5778487 | 9 | 9 |
| 5920-00-6884085 | 9 | 11 |
| 5930-00-6551508 | 9 | 53 |
| 5930-00-6816699 | 9 | 51 |
| 5930-00-8354777 | 2 | 31 |
| 5935-00-5205005 | 9 | 3 |
| 5935-00-7024199 | 9 | 23 |
| 5935-00-7620312 | 9 | 21 |

| STOCK NUMBER | FIGURE NO. | ITEM NO. |
|---|---|---|
| 5935-00-9136260 | 9 | 19 |
| 5945-00-2436403 | 9 | 47 |
| 5945-00-9430039 | 3 | 17 |
| 5945-00-9430039 | 5 | 29 |
| 5950-00-4213056 | 9 | 55 |
| 5950-00-7352686 | 9 | 57 |
| 5960-00-8800457 | 3 | 15 |
| 5960-00-8800457 | 9 | 5 |
| 5961-00-0540046 | 1 | 45 |
| 5961-00-0874138 | 1 | 43 |
| 5961-00-0874138 | 4 | 71 |
| 5961-00-1045726 | 2 | 33 |
| 5961-00-1045726 | 6 | 21 |
| 5961-00-1114795 | 6 | 31 |
| 5961-00-1114795 | 9 | 49 |
| 5961-00-1188433 | 2 | 41 |
| 5961-00-1240117 | 2 | 35 |
| 5961-00-1240117 | 6 | 23 |
| 5961-00-2265968 | 1 | 39 |
| 5961-00-2313747 | 1 | 41 |
| 5961-00-2313747 | 6 | 19 |
| 5961-00-4045537 | 2 | 37 |
| 5961-00-4154632 | 6 | 35 |
| 5961-00-4154632 | 9 | 67 |
| 5961-00-4190165 | 1 | 37 |
| 5961-00-4190165 | 9 | 61 |
| 5961-00-4190167 | 8 | 57 |
| 5961-00-4190167 | 9 | 63 |
| 5961-00-4223466 | 8 | 51 |
| 5961-00-4900234 | 2 | 39 |
| 5961-00-4979136 | 3 | 27 |
| 5961-00-4979136 | 9 | 59 |
| 5961-00-8405316 | 1 | 35 |
| 5961-00-8405316 | 4 | 69 |
| 5961-00-8920734 | 1 | 33 |
| 5961-00-8920734 | 4 | 65 |
| 5961-00-8920734 | 8 | 49 |
| 5961-00-9252109 | 6 | 33 |
| 5961-00-9270845 | 8 | 55 |
| 5961-00-9305326 | 4 | 67 |
| 5961-00-9305326 | 5 | 45 |
| 5961-00-9310152 | 3 | 29 |
| 5961-00-9479430 | 9 | 65 |
| 6150-00-0711180 | 2 | 43 |
| 6210-00-0772507 | 9 | 25 |
| 6210-00-4146784 | 1 | 17 |
| 6625-00-4418759 | 4 | 3 |
| 6625-00-4418761 | 8 | 3 |
| 6625-00-4506699 | 7 | 3 |
| 5961-00-4433953 | 9 | 69 |

| REFERENCE NO. | MFR CODE | FIG. NO. | ITEM NO. |
|---|---|---|---|
| BBS2 | 71400 | 9 | 9 |
| BF03ACS1762 | 03797 | 1 | 17 |
| BG03RCSNE2H033K | 03797 | 9 | 25 |
| BR2-450 | 14655 | 3 | 7 |
| BR2-450 | 14655 | 6 | 5 |
| CM05CD180J03 | 81349 | 3 | 11 |
| CM05ED240J03 | 81349 | 1 | 9 |
| CTM103VAJ | 81349 | 1 | 11 |
| CTM103VAJ | 81349 | 8 | 5 |
| DD101 | 71590 | 2 | 5 |
| DM15-100J | 84171 | 3 | 13 |
| DTS413 | 16758 | 9 | 65 |
| DTS423 | 16758 | 9 | 69 |
| FD1070 | 22229 | 1 | 37 |
| FD1070 | 22229 | 9 | 61 |
| F01A250V1-4A | 81349 | 9 | 13 |
| F098250V10A | 81349 | 9 | 11 |
| F1088A | 22229 | 8 | 57 |
| F1088A | 22229 | 9 | 63 |
| JAN1N483B | 81349 | 1 | 33 |
| JAN1N483B | 81349 | 4 | 65 |
| JAN1N483B | 81349 | 8 | 49 |
| JAN2N1711 | 81349 | 1 | 45 |
| KAP11AG120V | 77342 | 9 | 47 |
| MFP103 | 04713 | 2 | 41 |
| MM2005-2 | 04713 | 1 | 41 |
| MM2005-2 | 04713 | 6 | 19 |
| MPF151 | 04713 | 6 | 35 |
| MPF151 | 04713 | 9 | 67 |
| MRR1A | 78290 | 3 | 17 |
| MRR1A | 78290 | 5 | 29 |
| MS25100-23 | 96906 | 9 | 53 |
| M39024-10-02 | 81349 | 9 | 23 |
| M39024-10-03 | 81349 | 9 | 21 |
| M401 | 88865 | 7 | 3 |
| M404G1 | 88865 | 1 | 3 |
| M404G2 | 88865 | 1 | 5 |
| M405 | 88865 | 4 | 3 |
| M406 | 88865 | 8 | 3 |
| PA1007 | 71590 | 9 | 51 |
| RCR07G102JS | 81349 | 4 | 43 |
| RCR07G102JS | 81349 | 8 | 15 |
| RCR07G104JS | 81349 | 8 | 17 |
| RCR07G112JS | 81349 | 4 | 27 |
| RCR07G123JS | 81349 | 4 | 57 |
| RCR07G134JS | 81349 | 8 | 11 |
| RCR07G152JS | 81349 | 4 | 55 |
| RCR07G153JS | 81349 | 4 | 33 |
| RCR07G153JS | 81349 | 8 | 29 |
| RCR07G182JS | 81349 | 4 | 35 |
| RCR07G203JS | 81349 | 4 | 47 |
| RCR07G220JS | 81349 | 4 | 53 |
| RCR07G221JS | 81349 | 4 | 21 |
| RCR07G222JS | 81349 | 2 | 11 |
| RCR07G223JS | 81349 | 4 | 31 |
| RCR07G224JS | 81349 | 4 | 61 |
| RCR07G272JS | 81349 | 4 | 39 |
| RCR07G273JS | 81349 | 4 | 29 |
| RCR07G331JS | 81349 | 8 | 33 |
| RCR07G332JS | 81349 | 4 | 23 |
| RCR07G391JS | 81349 | 4 | 25 |
| RCR07G470JS | 81349 | 2 | 9 |
| RCR07G472JS | 81349 | 4 | 37 |
| RCR07G512JS | 81349 | 4 | 41 |
| RCR07G561JS | 81349 | 4 | 59 |
| RCR07G562JS | 81349 | 4 | 15 |
| RCR07G622JS | 81349 | 4 | 11 |
| RCR07G681JS | 81349 | 4 | 19 |
| RCR07G682JS | 81349 | 8 | 13 |
| RCR07G683JS | 81349 | 8 | 23 |
| RCR07G822JS | 81349 | 4 | 63 |
| RCR07G823JS | 81349 | 4 | 7 |
| RCR07G824JS | 81349 | 8 | 35 |
| RCR20G100JS | 81349 | 1 | 21 |
| RCR20G100JS | 81349 | 6 | 13 |
| RCR20G101JS | 81349 | 2 | 15 |
| RCR20G101JS | 81349 | 5 | 41 |
| RCR20G101JS | 81349 | 9 | 37 |
| RCR20G102JS | 81349 | 3 | 19 |
| RCR20G102JS | 81349 | 4 | 45 |
| RCR20G103JS | 81349 | 1 | 23 |
| RCR20G104JS | 81349 | 5 | 31 |
| RCR20G121JS | 81349 | 7 | 9 |
| RCR20G122JS | 81349 | 5 | 21 |
| RCR20G123JS | 81349 | 7 | 13 |
| RCR20G131JS | 81349 | 2 | 25 |
| RCR20G131JS | 81349 | 5 | 7 |
| RCR20G131JS | 81349 | 5 | 43 |
| RCR20G131JS | 81349 | 9 | 33 |
| RCR20G135JS | 81349 | 1 | 25 |
| RCR20G150JS | 81349 | 5 | 33 |
| RCR20G150JS | 81349 | 6 | 27 |

| REFERENCE NO. | MFR CODE | FIG. NO. | ITEM NO. |
|---|---|---|---|
| RCR20G150JS | 81349 | 9 | 35 |
| RCR20G151JS | 81349 | 2 | 17 |
| RCR20G151JS | 81349 | 6 | 9 |
| RCR20G152JS | 81349 | 6 | 15 |
| RCR20G152JS | 81349 | 7 | 11 |
| RCR20G153JS | 81349 | 7 | 15 |
| RCR20G154JS | 81349 | 4 | 49 |
| RCR20G155JS | 81349 | 2 | 21 |
| RCR20G163JS | 81349 | 8 | 43 |
| RCR20G182JS | 81349 | 4 | 17 |
| RCR20G183JS | 81349 | 1 | 29 |
| RCR20G183JS | 81349 | 7 | 7 |
| RCR20G202JS | 81349 | 1 | 31 |
| RCR20G221JS | 81349 | 9 | 39 |
| RCR20G222JS | 81349 | 4 | 13 |
| RCR20G222JS | 81349 | 5 | 13 |
| RCR20G222JS | 81349 | 6 | 17 |
| RCR20G223JS | 81349 | 2 | 13 |
| RCR20G223JS | 81349 | 8 | 19 |
| RCR20G272JS | 81349 | 5 | 17 |
| RCR20G332JS | 81349 | 5 | 5 |
| RCR20G332JS | 81349 | 8 | 47 |
| RCR20G335JS | 81349 | 5 | 27 |
| RCR20G362JS | 81349 | 1 | 19 |
| RCR20G390JS | 81349 | 5 | 35 |
| RCR20G390JS | 81349 | 9 | 31 |
| RCR20G432JS | 81349 | 8 | 45 |
| RCR20G470JS | 81349 | 5 | 25 |
| RCR20G472JS | 81349 | 5 | 19 |
| RCR20G474JS | 81349 | 2 | 23 |
| RCR20G511JS | 81349 | 7 | 17 |
| RCR20G512JS | 81349 | 8 | 9 |
| RCR20G561JS | 81349 | 6 | 25 |
| RCR20G562JS | 81349 | 8 | 37 |
| RCR20G681JS | 81349 | 1 | 27 |
| RCR20G682JS | 81349 | 5 | 15 |
| RCR20G683JS | 81349 | 4 | 51 |
| RCR20G683JS | 81349 | 9 | 27 |
| RCR20G684JS | 81349 | 6 | 11 |
| RCR20G684JS | 81349 | 9 | 29 |
| RCR20G685JS | 81349 | 5 | 9 |
| RCR20G750JS | 81349 | 8 | 27 |
| RCR20G752JS | 81349 | 8 | 25 |
| RCR20G820JS | 81349 | 2 | 19 |
| RCR20G821JS | 81349 | 5 | 23 |
| RCR20G822JS | 81349 | 8 | 41 |
| RCR20G824JS | 81349 | 3 | 21 |
| RCR32G122JS | 81349 | 4 | 9 |
| RCR32G221JS | 81349 | 8 | 21 |
| RCR32G821JS | 81349 | 8 | 31 |
| RF147 | 82877 | 9 | 7 |
| RNR65C1002FS | 81349 | 2 | 27 |
| RNR65C1002FS | 81349 | 5 | 39 |
| RNR65C1003FS | 81349 | 2 | 29 |
| RNR65C1003FS | 81349 | 5 | 37 |
| RNR65C1401FS | 81349 | 5 | 11 |
| RNR65C1503FS | 81349 | 3 | 25 |
| RNR65C1503FS | 81349 | 6 | 29 |
| RNR65C7502FS | 81349 | 3 | 23 |
| RP25GB | 58474 | 9 | 3 |
| RS25GR | 58474 | 9 | 19 |
| RV4NAYSD102A | 81349 | 9 | 45 |
| SW126 | 88869 | 2 | 31 |
| TPG175T15 | 37942 | 3 | 9 |
| WMF1S1 | 14655 | 1 | 15 |
| WMF1S1 | 14655 | 2 | 7 |
| WMF1S1 | 14655 | 4 | 5 |
| WMF1S1 | 14655 | 6 | 7 |
| WMF2D1 | 14655 | 1 | 13 |
| 01-426 | 24862 | 9 | 57 |
| 01-427A | 24862 | 9 | 55 |
| 0217 | 44655 | 9 | 43 |
| 1N5061 | 03508 | 6 | 31 |
| 1N5061 | 03508 | 9 | 49 |
| 10015417-056 | 18876 | 2 | 45 |
| 10015417-056 | 18876 | 3 | 5 |
| 10015620-207 | 18876 | 8 | 39 |
| 11065337-004 | 18876 | 7 | 5 |
| 15-031 | 24862 | 2 | 3 |
| 15-036 | 24862 | 9 | 73 |
| 15-041 | 24862 | 9 | 71 |
| 15-218 | 24862 | 3 | 3 |
| 15-221 | 24862 | 6 | 3 |
| 15-222 | 24862 | 5 | 3 |
| 150D105X0035A2 | 56289 | 1 | 7 |
| 150D105X0035A2 | 56289 | 8 | 7 |
| 17419S | 70903 | 2 | 43 |
| 18-001 | 24862 | 4 | 73 |
| 2N3391 | 80131 | 3 | 29 |
| 2N3392 | 03508 | 6 | 33 |
| 2N3605 | 80131 | 2 | 33 |
| 2N3605 | 80131 | 6 | 21 |
| 2N3640 | 07263 | 8 | 55 |
| 2N3702 | 01295 | 4 | 67 |
| 2N3702 | 01295 | 5 | 45 |
| 2N3703 | 01295 | 1 | 35 |
| 2N3703 | 01295 | 4 | 69 |
| 2N3708 | 80131 | 1 | 43 |
| 2N3708 | 80131 | 4 | 71 |
| 2N3711 | 01295 | 1 | 39 |
| 2N3860 | 03508 | 2 | 39 |
| 2N412H | 04713 | 8 | 51 |
| 2N4403 | 04713 | 2 | 35 |
| 2N4403 | 04713 | 6 | 23 |
| 2N4889 | 07263 | 3 | 27 |
| 2N4889 | 07263 | 9 | 59 |
| 2N5087 | 04713 | 2 | 37 |
| 6DJ8 | 81349 | 3 | 15 |
| 6DJ8 | 81349 | 9 | 5 |
| 9163050 | 18876 | 9 | 41 |

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# APPENDIX A

## REFERENCES

Following is a list of publications available to the Ac Precision Power Supply (SF 613-1) operator and maintenance personnel.

| | |
|---|---|
| DA Pam 310-4 | Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders. |
| DA Pam 310-7 | U. S. Army Equipment Index of Modification Work Orders. |
| TM 38-750 | The Army Maintenance Management System (TAMMS). |
| SB 38-100 | Preservation, Packaging, Packing, and Marking Materials, Supplies, and Equipment used by the Army. |
| TB 746-10 | Field Instruction for Painting and Preserving Electronic Equipment. |
| TB 750-236 | Calibration Requirements for Maintenance of Army Materiel. |

# APPENDIX B

# BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

## SECTION I

## INTRODUCTION

B-1 SCOPE

B-1.1 This appendix lists items which accompany Ac Precision Power Supply SF 613-1 or are required for installation, operation, or maintenance.

B-2 GENERAL

B-2.1 This Basic Issue Items List and Items Troop Installed or Authorized list is divided into the following sections:

(a) Basic Issue Items - Section II. A list of items which accompany Ac Precision Power Supply SF 613-1 and are required by operator/crew for installation operation, or maintenance.

(b) Items Troop Installed or Authorized List - Section III - not applicable.

SECTION II

BASIC ISSUE ITEMS LIST

| Description | Unit of Meas | Qty Furn with Equip | Illustration | |
|---|---|---|---|---|
| | | | Figure No | Item No |
| GENERAL PURPOSE OUTPUT LEAD, BLACK NO 12 WIRE WITH HIGH CURRENT SPADE LUG, 5000-VOLT INSULATED WIRE, AND A 25-AMPERE RECEPTICLE | EA | 1 | | |
| GENERAL PURPOSE OUTPUT LEAD, RED No 12 WIRE WITH HIGH CURRENT SPADE LUB, 5000-VOLT INSULATED WIRE, AND A 25-AMPERE RECEPTICLE | EA | 1 | N/A | N/A |
| 18-INCH RG-58/U CABLE WITH BNC PLUG TERMINATIONS | EA | 1 | N/A | N/A |

APPENDIX C

MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART Date: 28 March 1972

Nomenclature of End Item or Component:

AC PRECISION POWER SUPPLY MIS-10222A

This Maintenance Allocation Chart designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of field maintenance tasks upon this end item or component will be consistent with the assigned maintenance operations which are defined as follows:

| Operation | Definition |
|---|---|
| Depot | That level of logistics which has the facilities, personnel and capabilities to equal the quality of the equipment repair available at the contractor's facilities. (D) |
| Reference | That level in the maintenance of calibration equipment which provides DS and GS logistical support. (H) |
| Transfer | That level in the maintenance of calibration equipment which provides organizational and limited DS logistical support to Secondary Transfer equipment. (F) |

MAINTENANCE ALLOCATION CHART

FOR POWER SUPPLY, AC PRECISION, N. H. RESEARCH, INC., MODEL SF 613-1

CHART NUMBER MIS-10222A

MAC PAGE

| GROUP NUMBER | FUNCTIONAL GROUP | MAINTENANCE FUNCTIONS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | a INSPECT | b TEST | c SERVICE | d ADJUST | e ALIGN | f CALIBRATE | g INSTALL | h REPLACE | i REPAIR | j OVERHAUL | k REBUILD | l TOOL REQD. | m REMARKS |
| 1 | AC PRECISION POWER SUPPLY | F | F | F | - | - | F | F | F | F | D | - | ALL | A |
| 2 | EXCITER UNIT 15-221 | F | | | | | | | F | D | D | | | B |
| 3 | POWER SUPPLY 15-218 | F | | | | | | | F | D | D | | | B |
| 4 | METER OVERLOAD 15-222 | F | | | | | | | F | D | D | | | B |
| 5 | BUFFER AMPLIFIER 15-031 | F | | | | | | | F | D | D | | | B |
| 6 | POWER SUPPLY M401 | F | | | | | | | F | D | D | | | B |
| 7 | QUAD AMPLIFIER M404(G-1) | F | | | | | | | F | D | D | | | B |
| 8 | MAIN AMPLIFIER M404(G-2) | F | | | | | | | F | D | D | | | B |
| 9 | MAIN AVC M405 | F | | | | | | | F | D | D | | | B |
| 10 | REFERENCE AVC M406 | F | | | | | | | F | D | D | | | B |

## MAINTENANCE ALLOCATION CHART

FOR POWER SUPPLY, AC PRECISION, N. H. RESEARCH, INC., MODEL SF 613-1

CHART NUMBER MIS-10222A

TOOLS REQUIRED PAGE

| TOOL CODE | CATEGORY | NOMENCLATURE | TOOL NUMBER |
|---|---|---|---|
| | F | AC/DC VOLTMETER, JF 887AB | MIS-10216 |
| | F | AUTOTRANSFORMER, GR W10MT3AS3 | 7910809 |
| | F | DISTORTION ANALYZER, H-P 334A | 7911957 |
| | F | FREQUENCY COUNTER, SYSTRON-DONNER 1037M | 7910823 |
| | F | CABLE 30 IN. RG-58/U | 7907467 |
| | F | TOOL KIT | 7659911 |
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## MAINTENANCE ALLOCATION CHART

FOR POWER SUPPLY, AC PRECISION, N. H. RESEARCH, INC., MODEL SF 613-1

CHART NUMBER MIS-10222A

REMARKS PAGE

| REMARKS CODE | REMARKS |
|---|---|
| A | Test in accordance with calibration procedure TB 9-4931-443-50. |
| B | Boards under exchange program. |
| | |
| | |
| |

By Order of the Secretary of the Army:

W. C. WESTMORELAND
General, United States Army
Chief of Staff

Official:
VERNE L. BOWERS
Major General, United States Army
The Adjutant General

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